Tech.

Gas Journal

VOL. 283. 107th YEAR. LONDON, JULY 6, 1955 No. 4805. PRICE 1/3

TECHNOLOGY DEPT.

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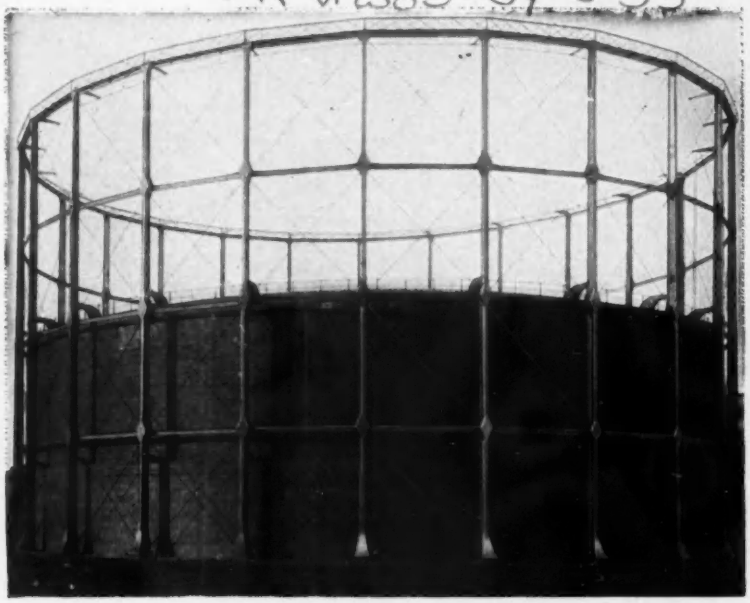

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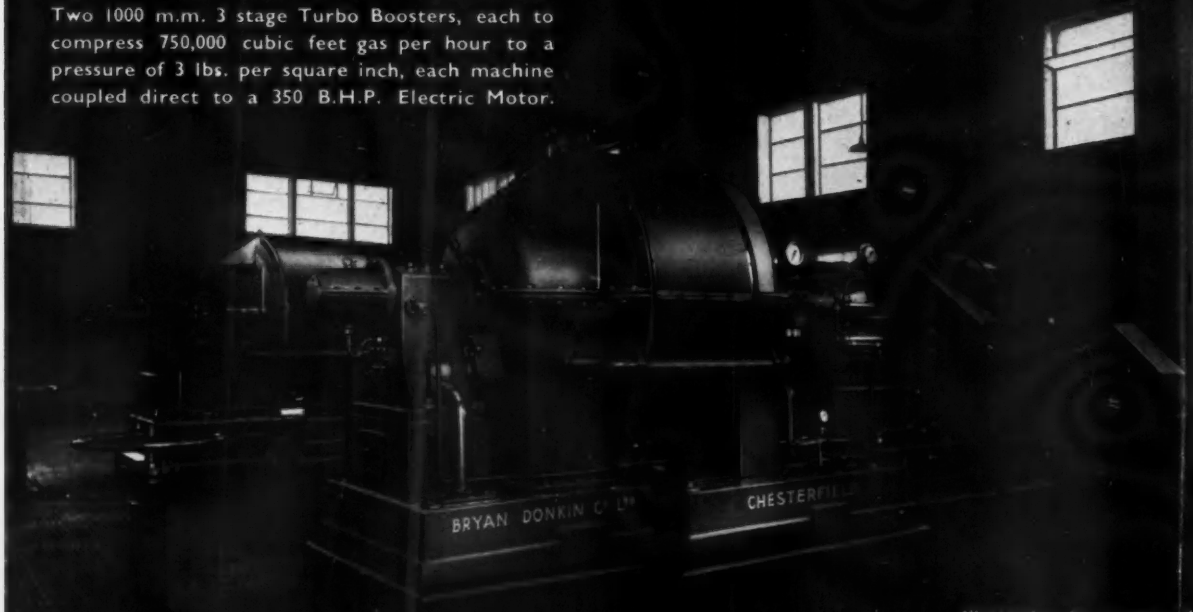

Illustration by courtesy of Scottish Gas Board, Ed. Div.

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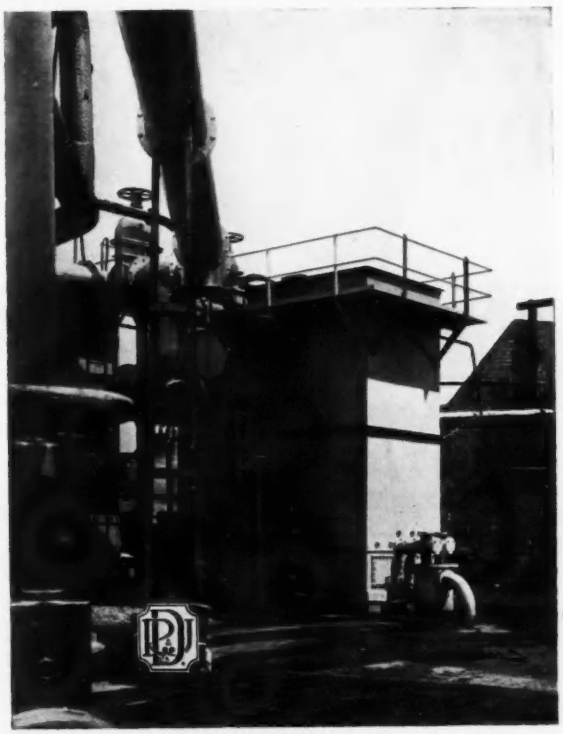

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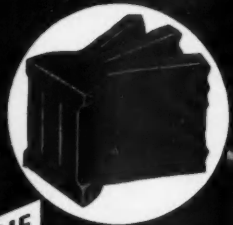

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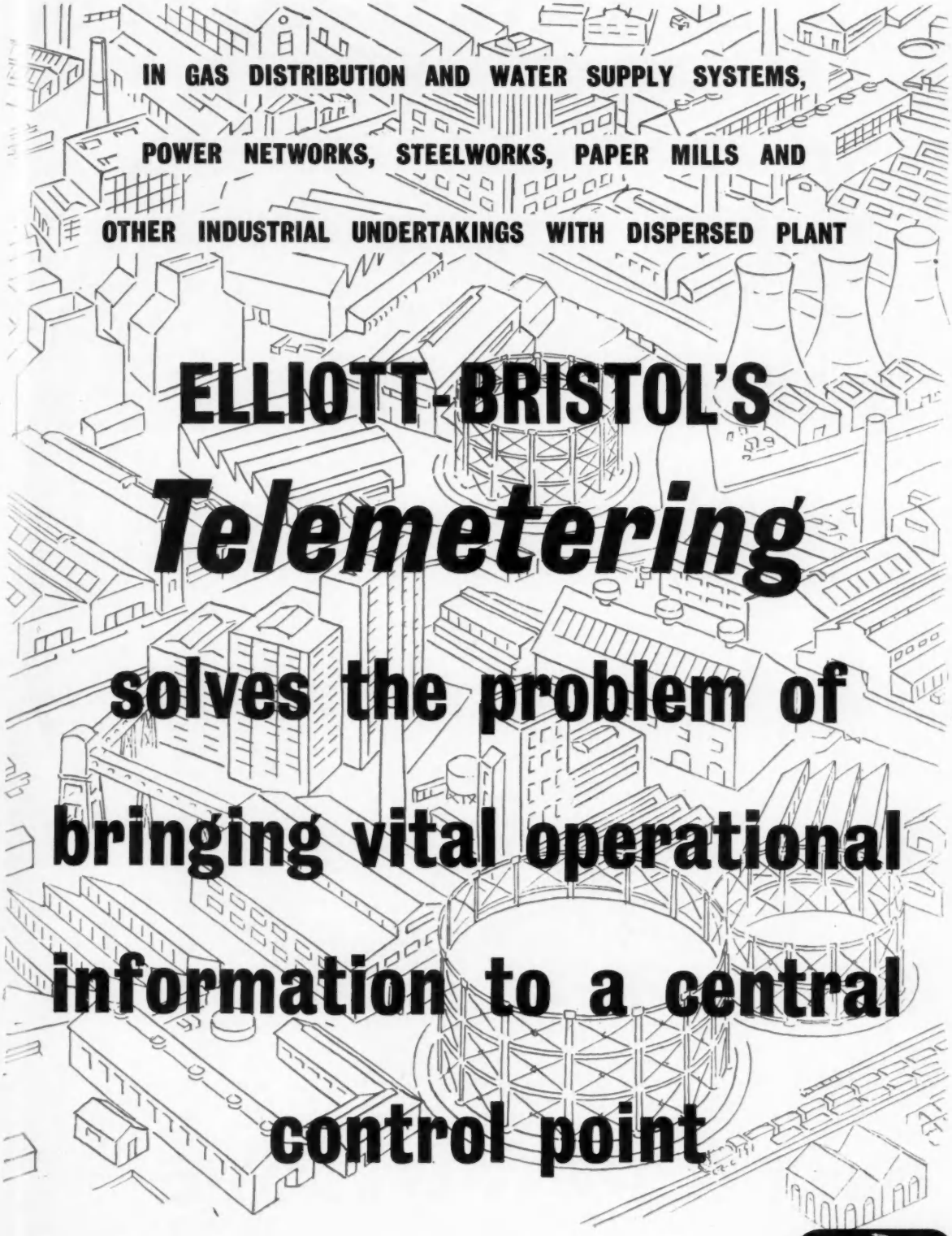

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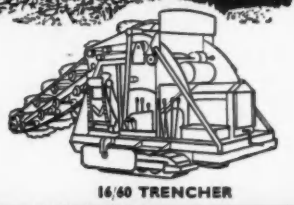

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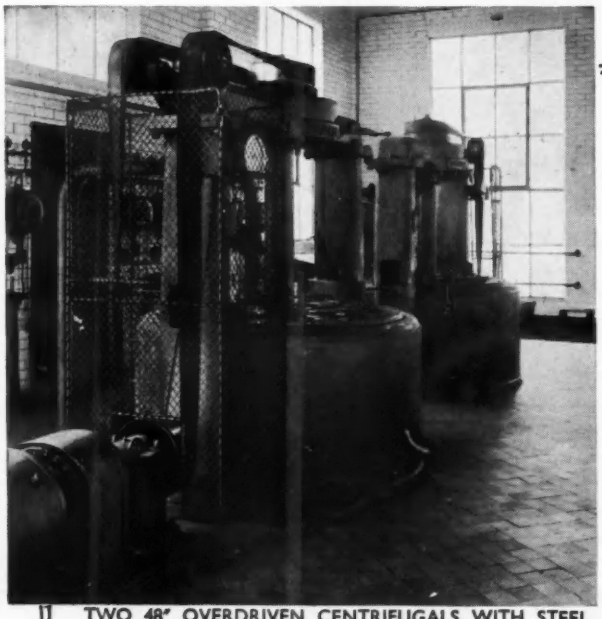

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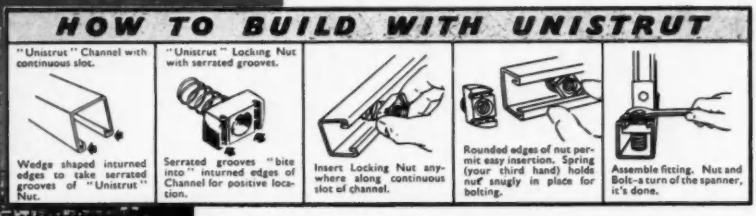
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Assemble fitting. Nut and Bolt–a turn of the spanner, it's done.

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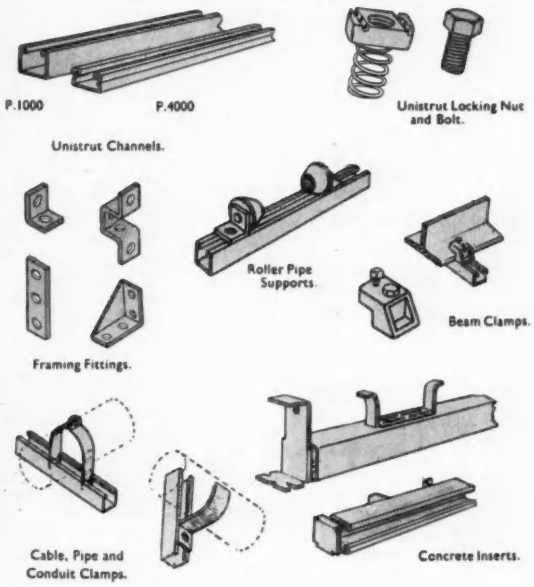

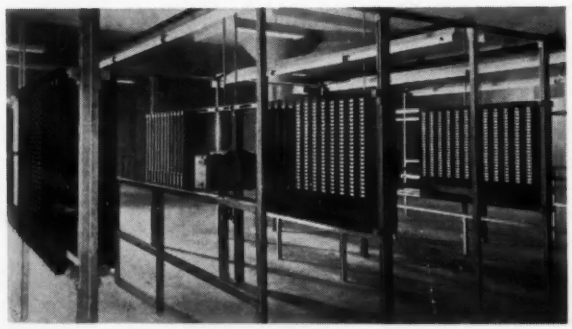

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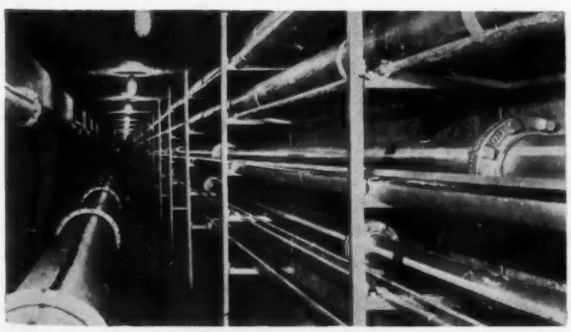

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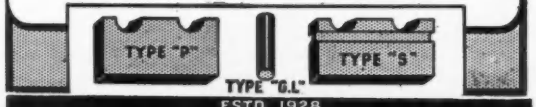

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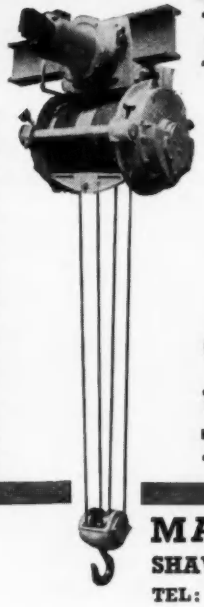

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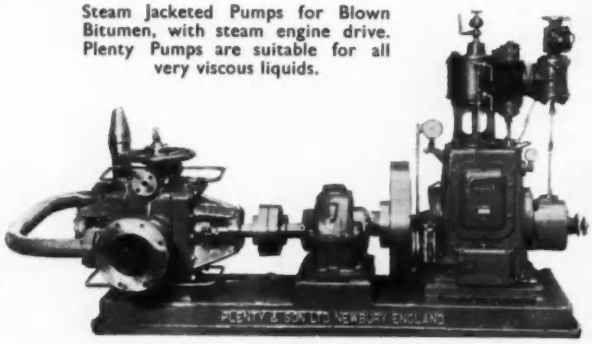

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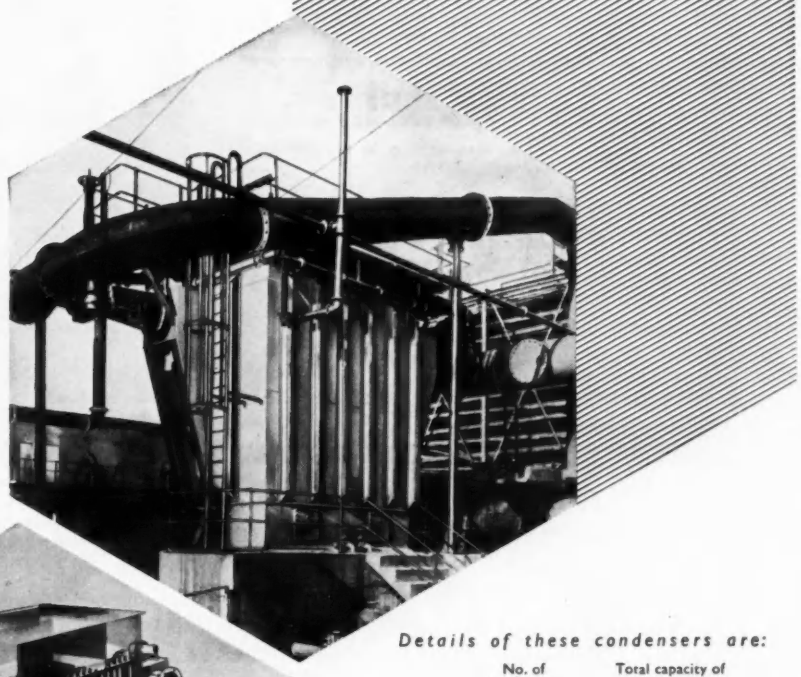

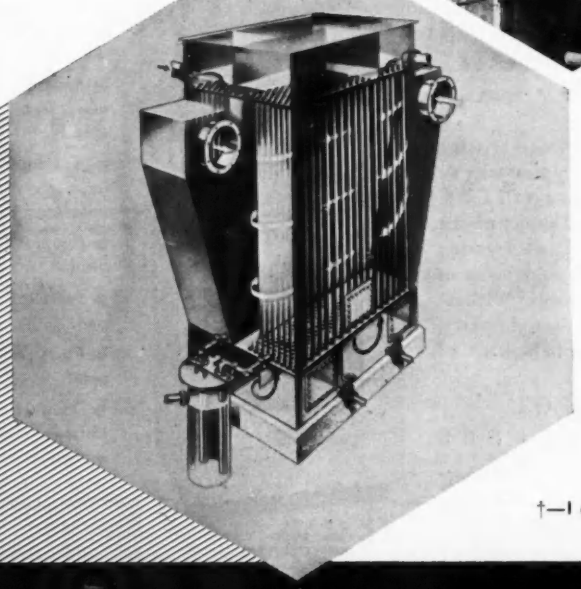

Details of these condensers are:

	No. of condensers	Total capacity of condensing plant
ABERAVON -	2 (s)	6½ mill. cu.ft. per day
BOLTON - -	2 (s)	8 mill. cu.ft. per day
CONSETT - -	2 (p)	16 mill. cu.ft. per day†
DEVONPORT	1	2½ mill. cu.ft. per day*
GILLINGHAM	2 (s)	3 mill. cu.ft. per day
LINACRE - -	2 (p)	8 mill. cu.ft. per day*
NEEPSEND -	2 (p)	10 mill. cu.ft. per day
PAISLEY - -	2 (p)	8 mill. cu.ft. per day*
REDDITCH -	2 (p)	3½ mill. cu.ft. per day*

s—series p—parallel *—operating
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- *Automatic regulator gives* double control.
- *Roomy plinth drawer.*
- *Self-locating grill pan.*
- *Fully-furnished oven.*
- *Good choice of finishes and oven capacities.*

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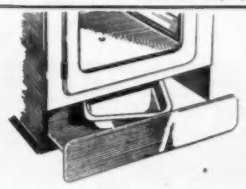
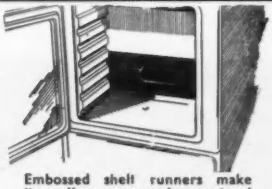


The Vulcan's splinth drawer is really useful for getting pans, shelves and utensils out of the way.

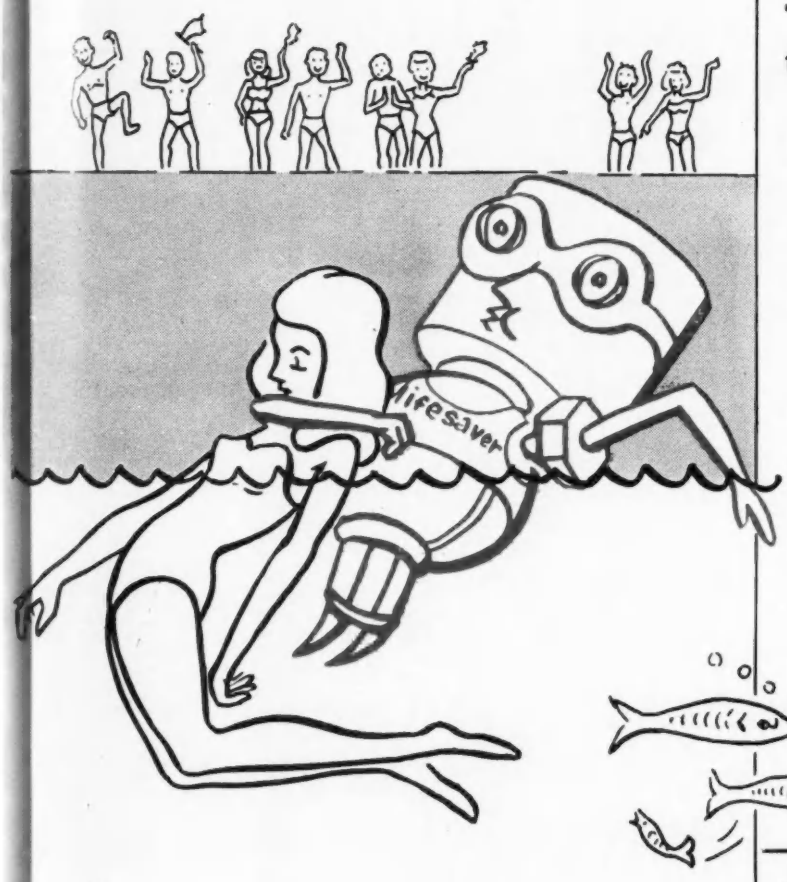


Embossed shelf runners make "gates" unnecessary. An occasional wipe with a damp cloth keeps this oven spotless.

Vitreous enamelled hot-plate sections carry the spillage pans, which prevent contamination of the burners. Parts lift off easily for cleaning.

***Point out these Vulcan advantages* YOUR SALES WILL BENEFIT!**

On the subject of CONTROL



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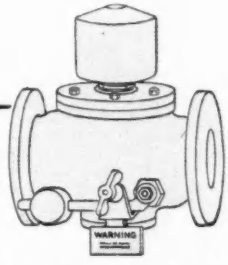

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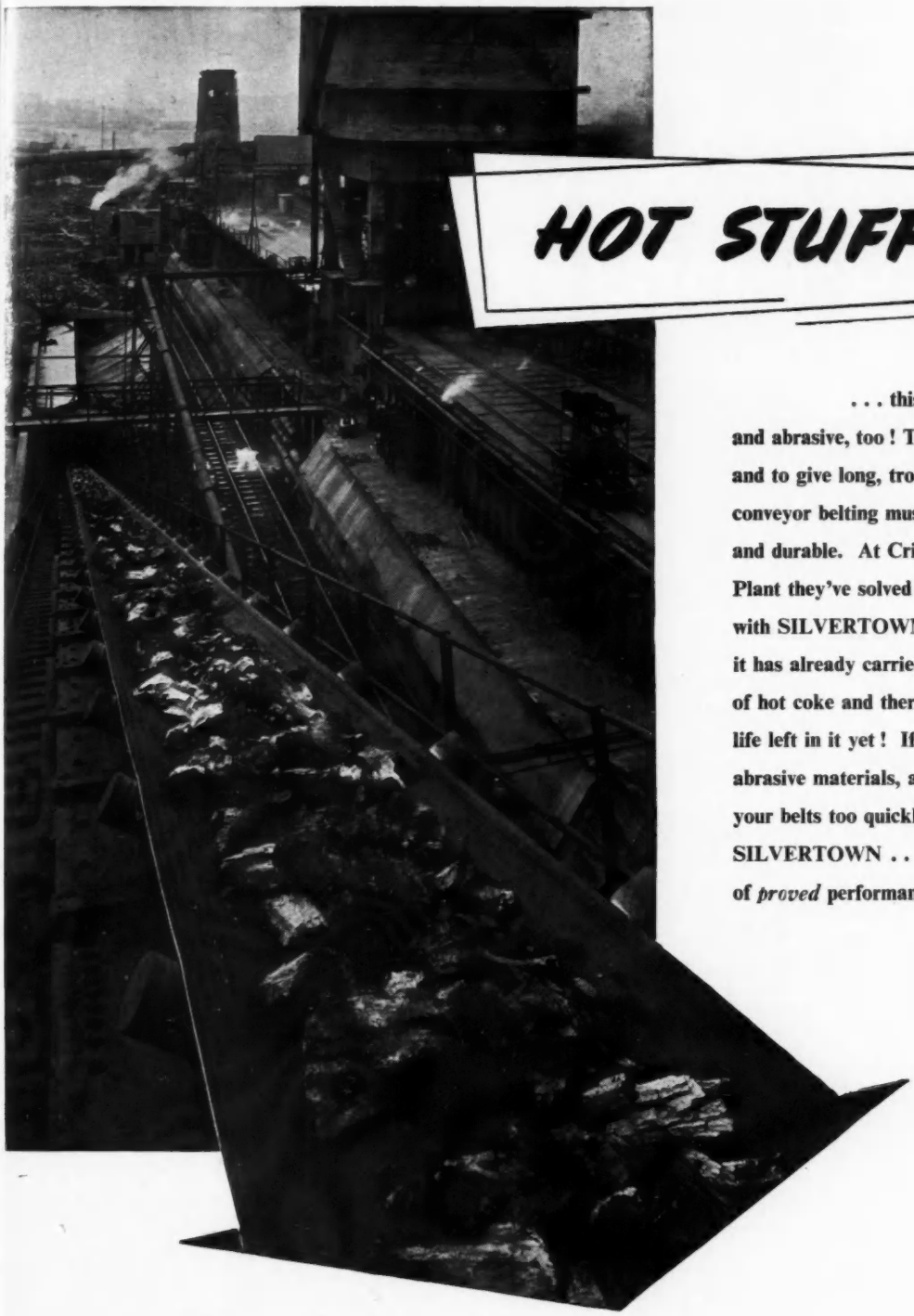

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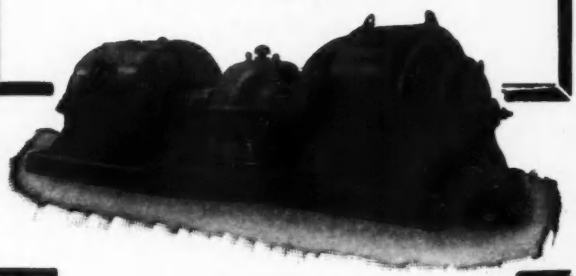

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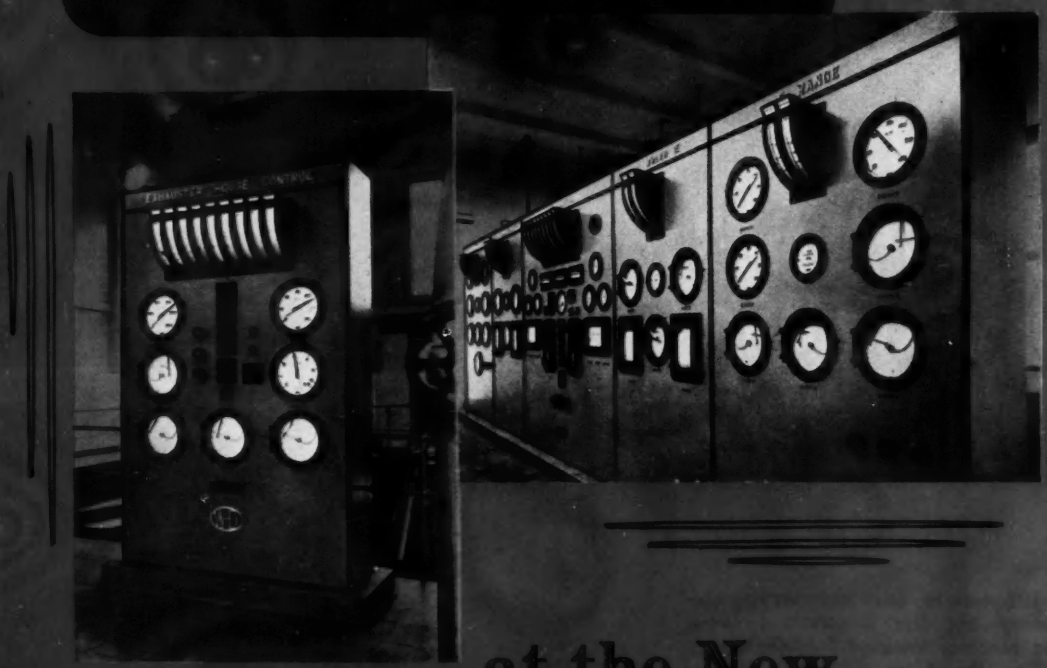

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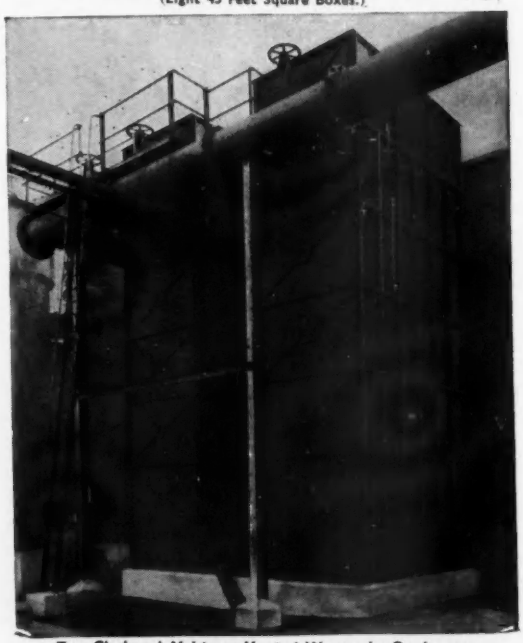

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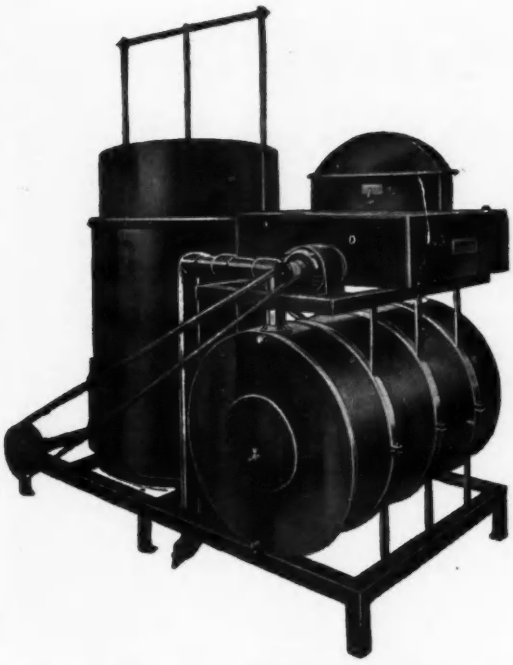

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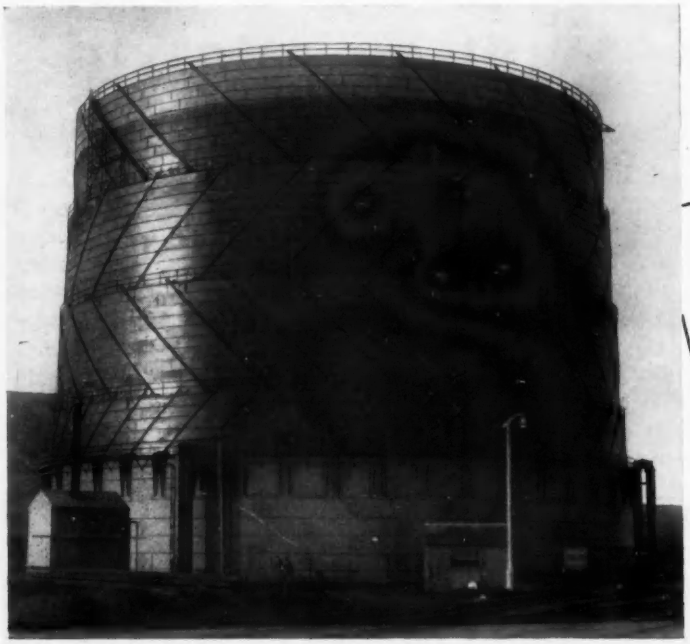

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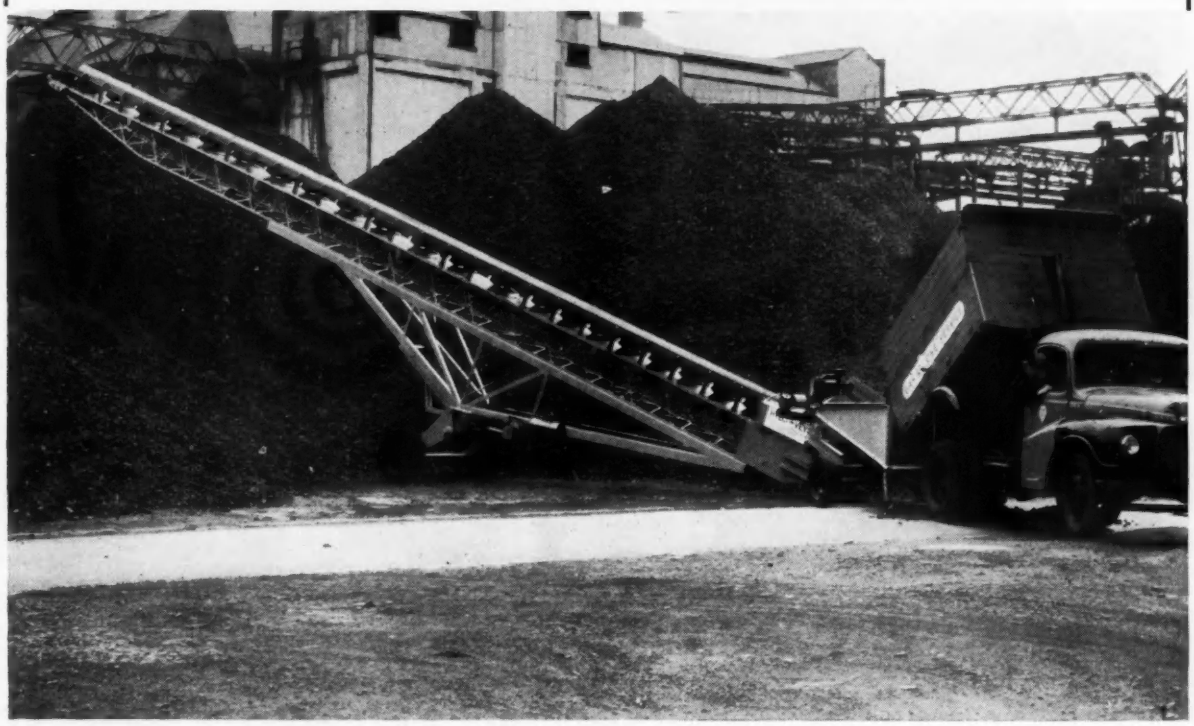

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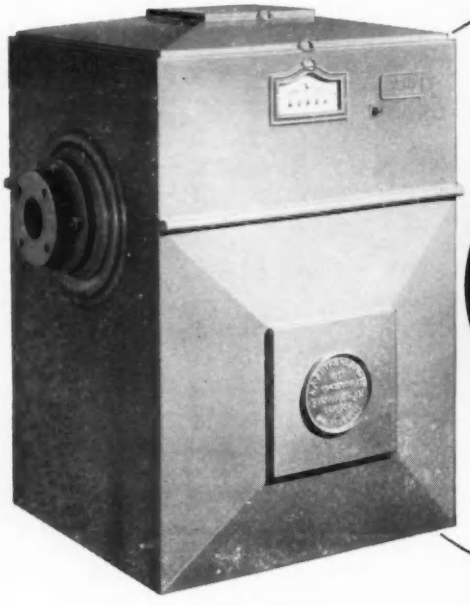

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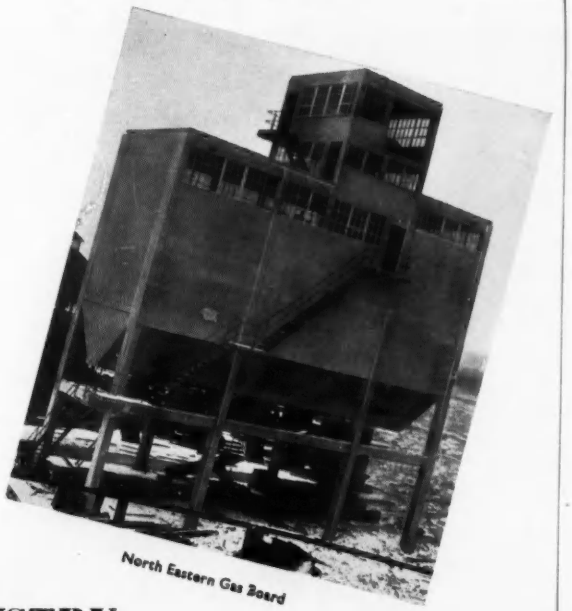

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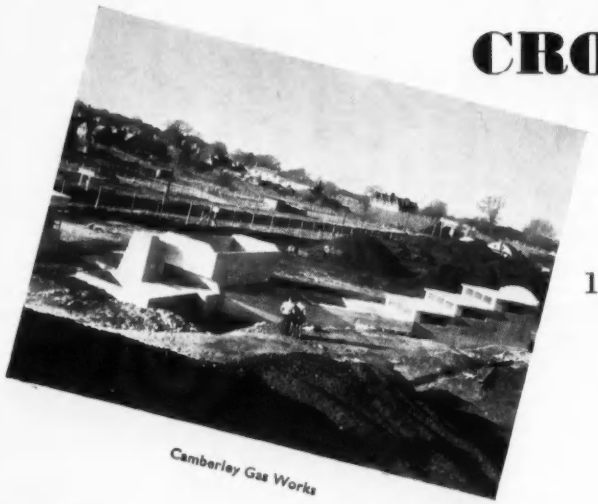

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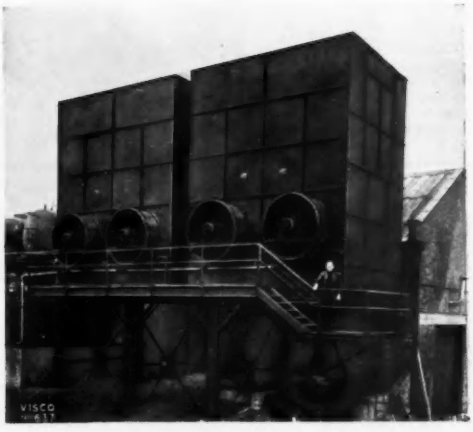

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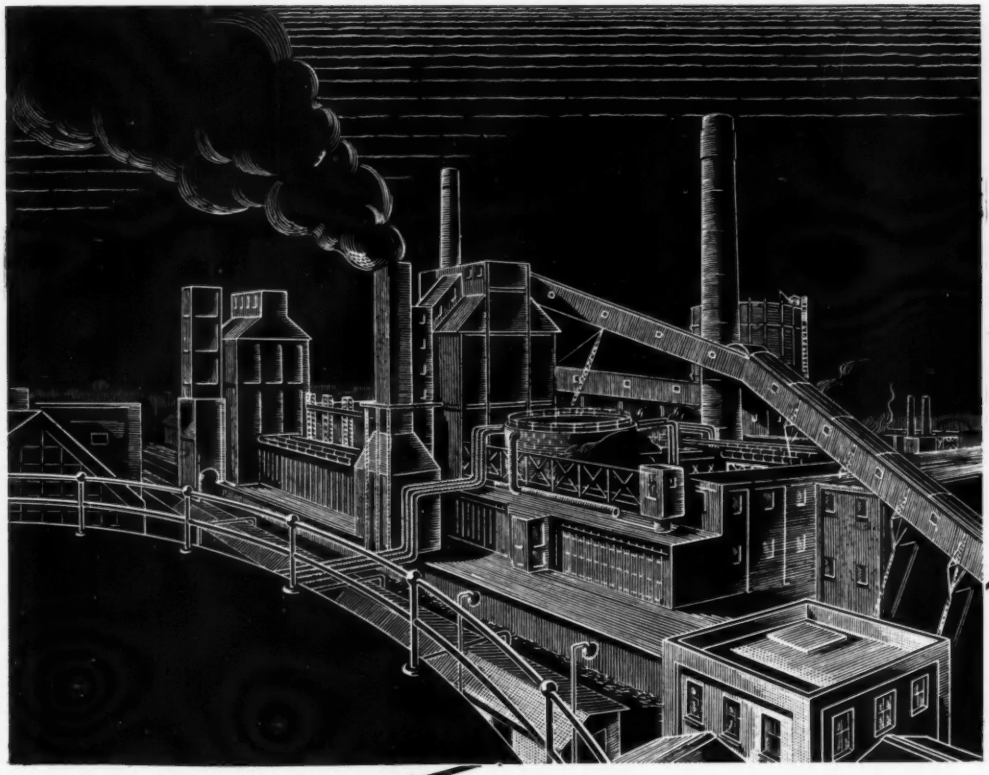

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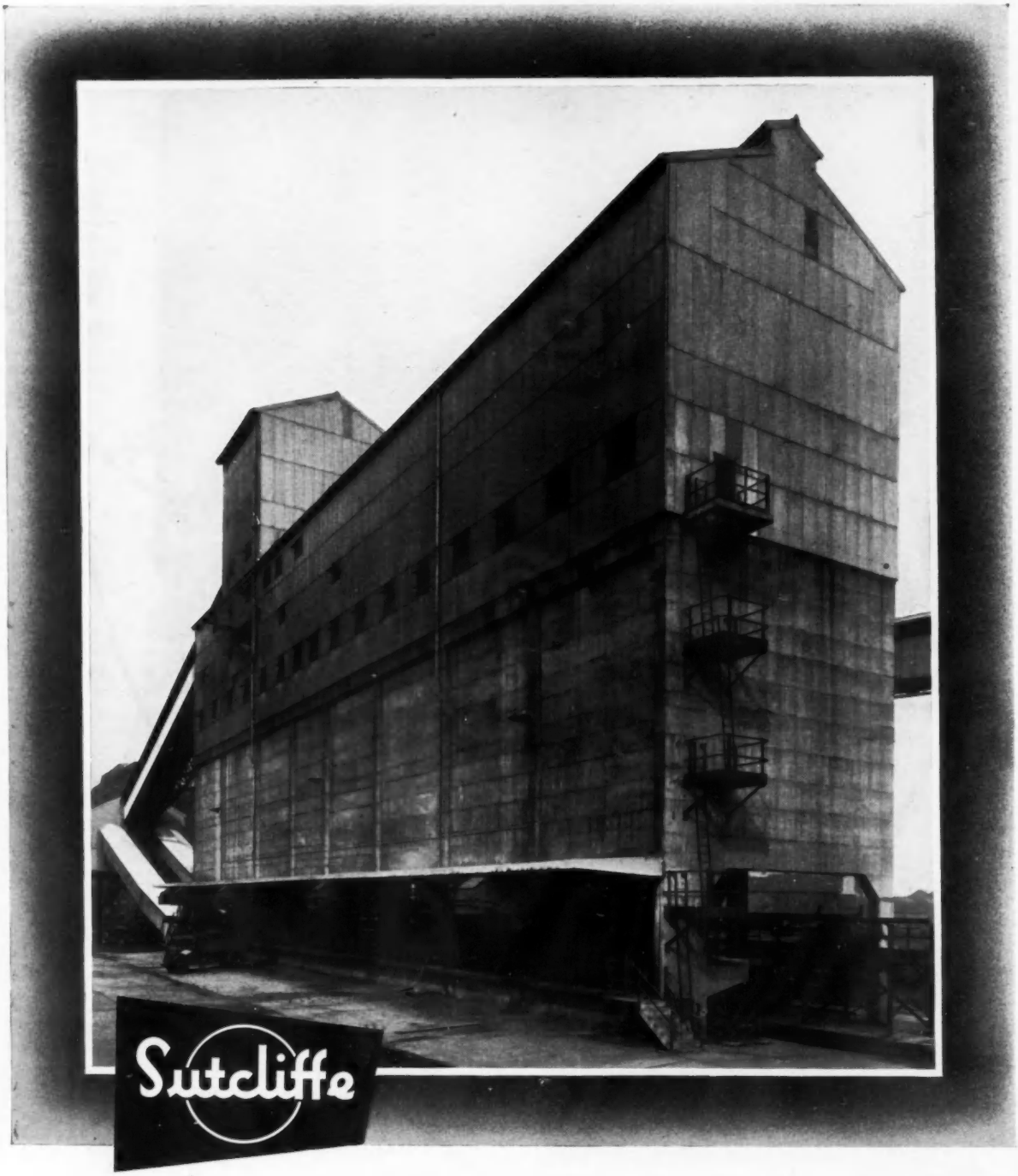

COAL & COKE CONVEYORS

At the Bromley-by-Bow works of the North Thames Gas Board, 15 Sutcliffe belt conveyors carry coke from the retorts through the screens to the bunker house illustrated above.

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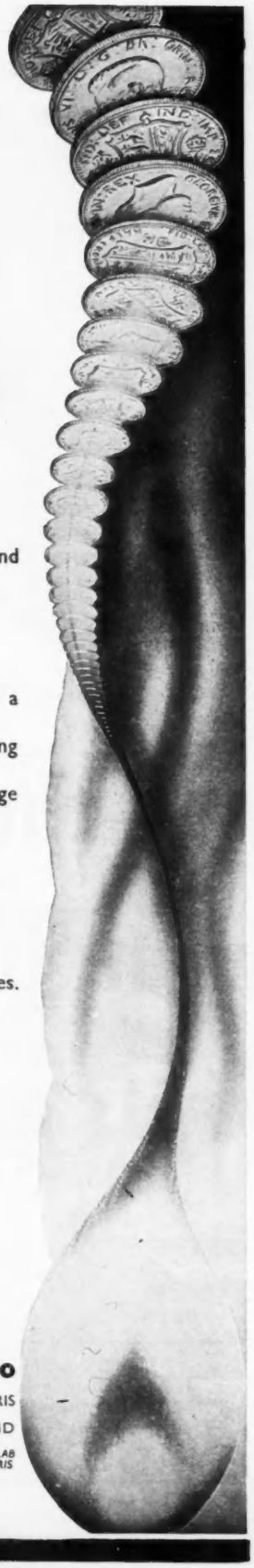

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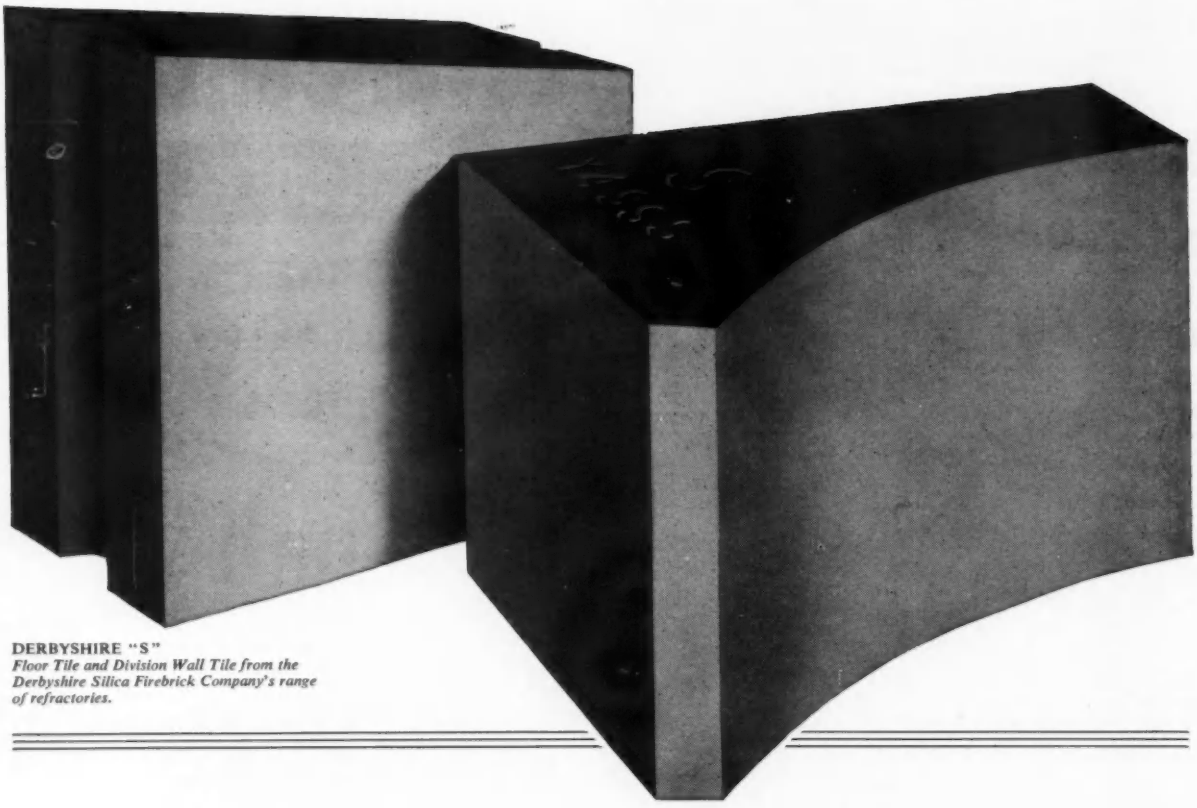

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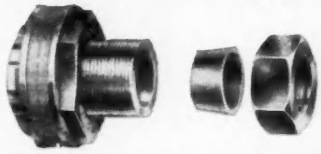

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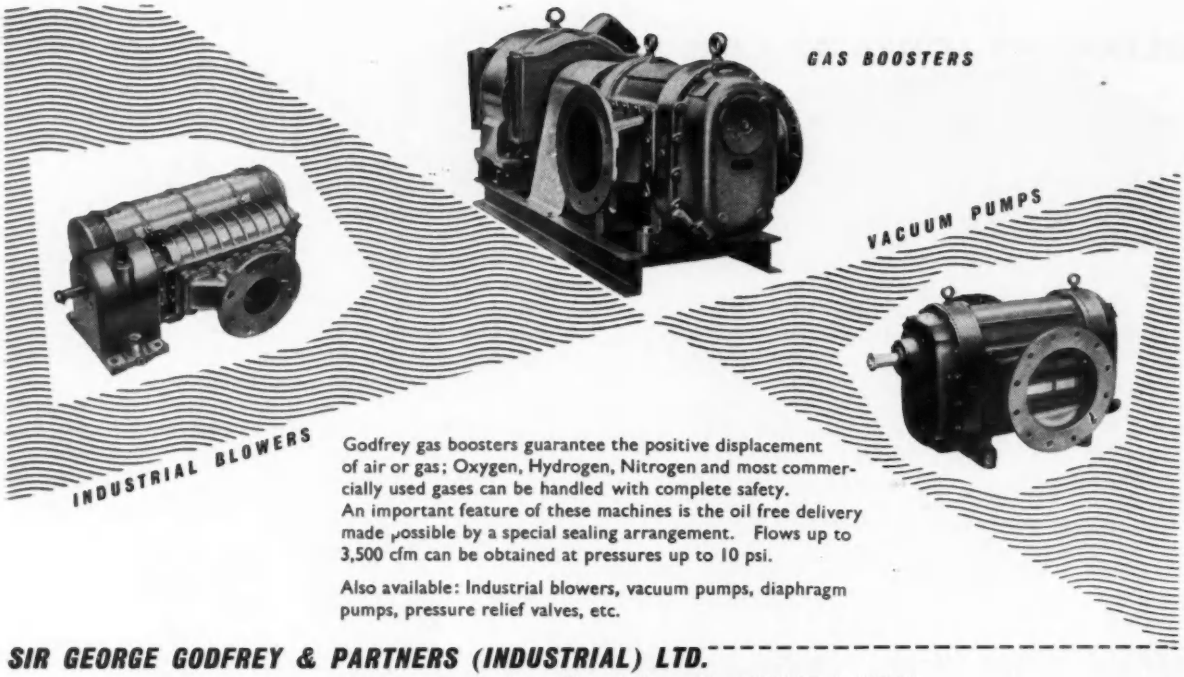

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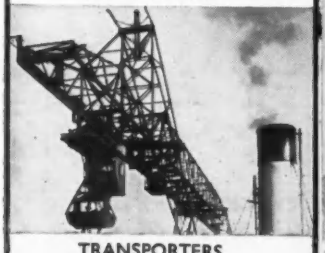
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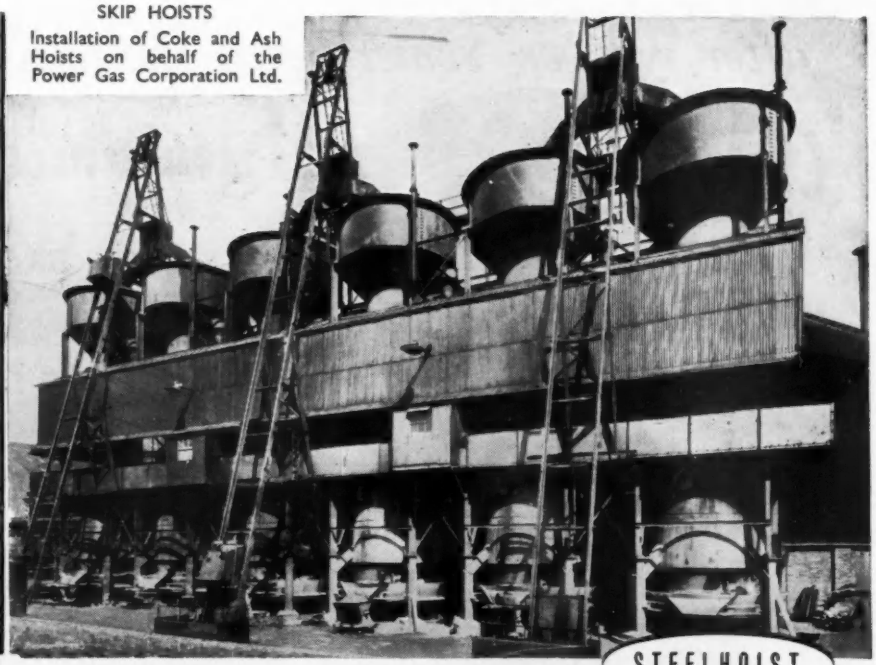

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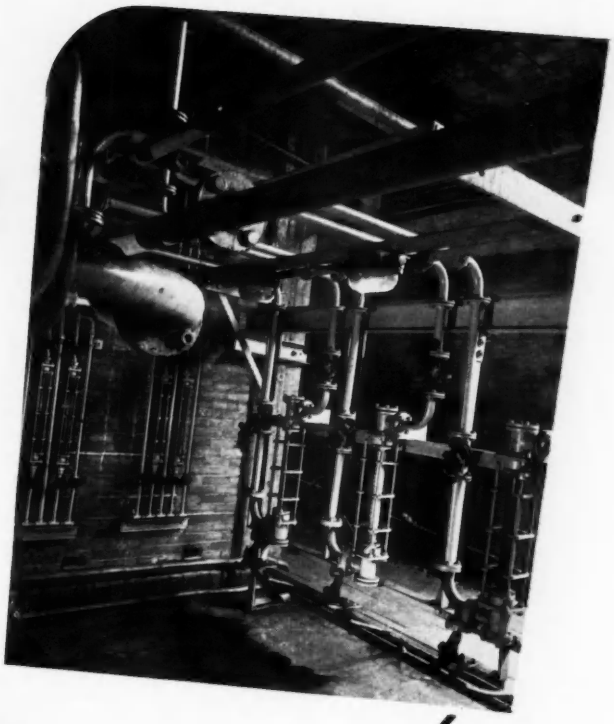

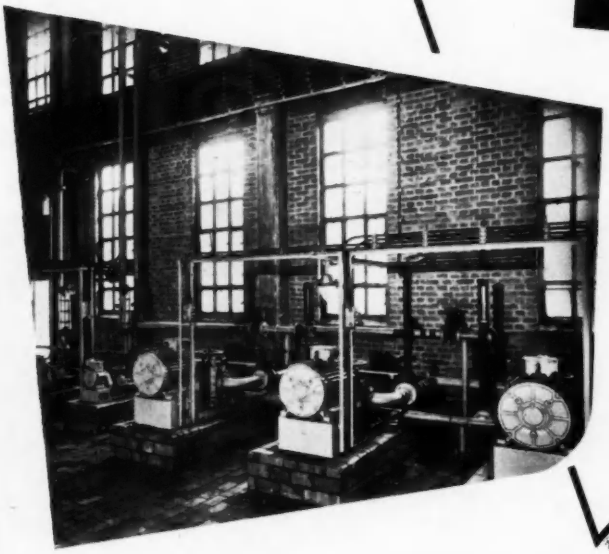

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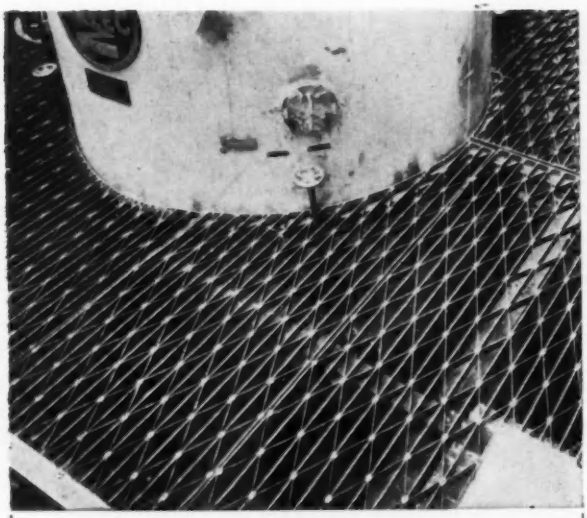

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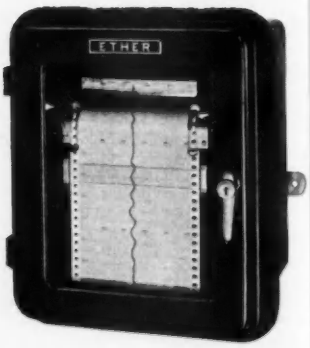

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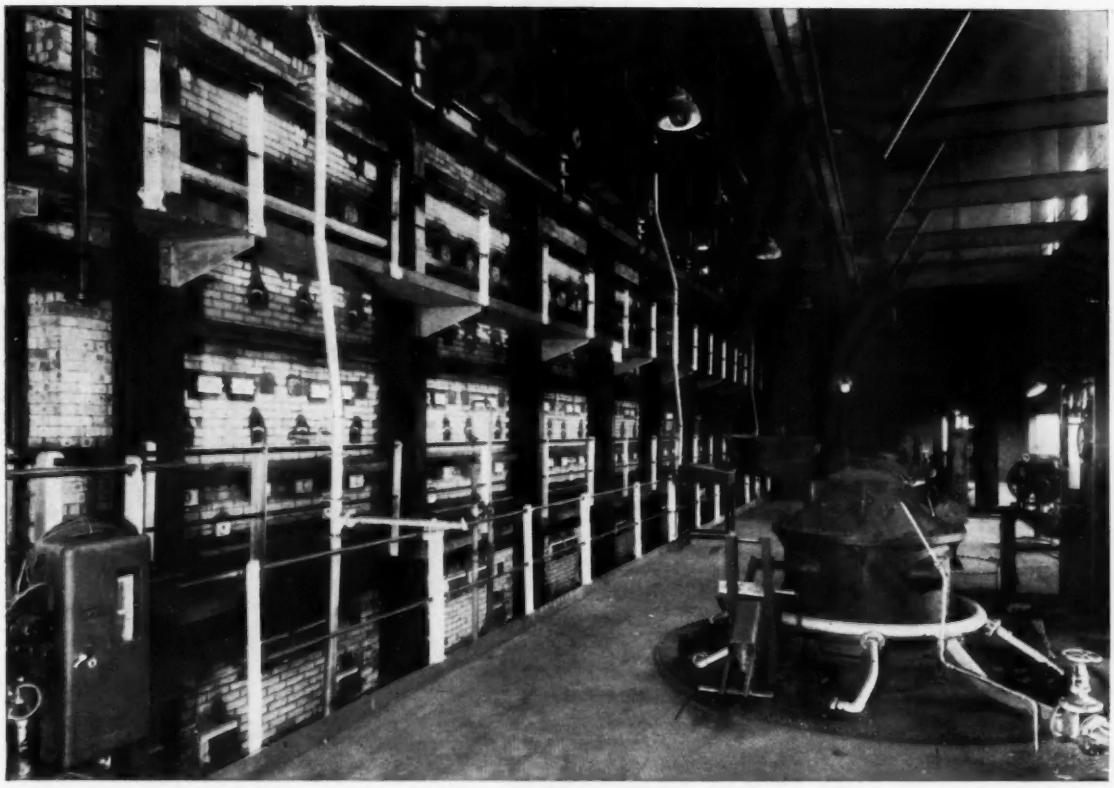

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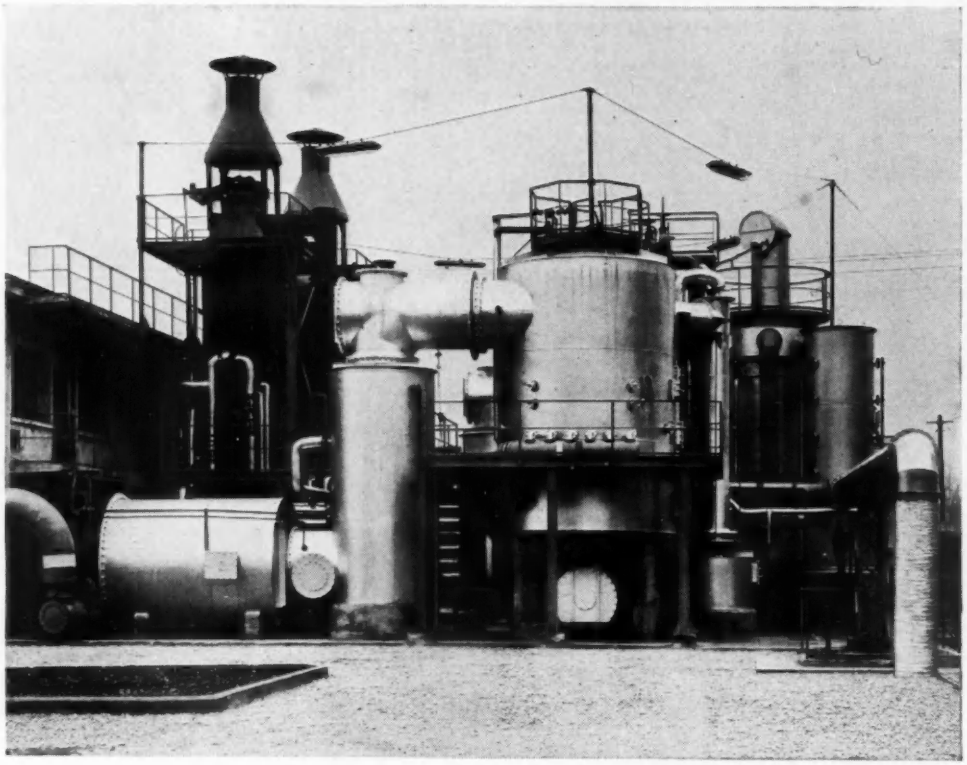

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Gas Journal

VOL. 283 NO. 4805 July 6, 1955

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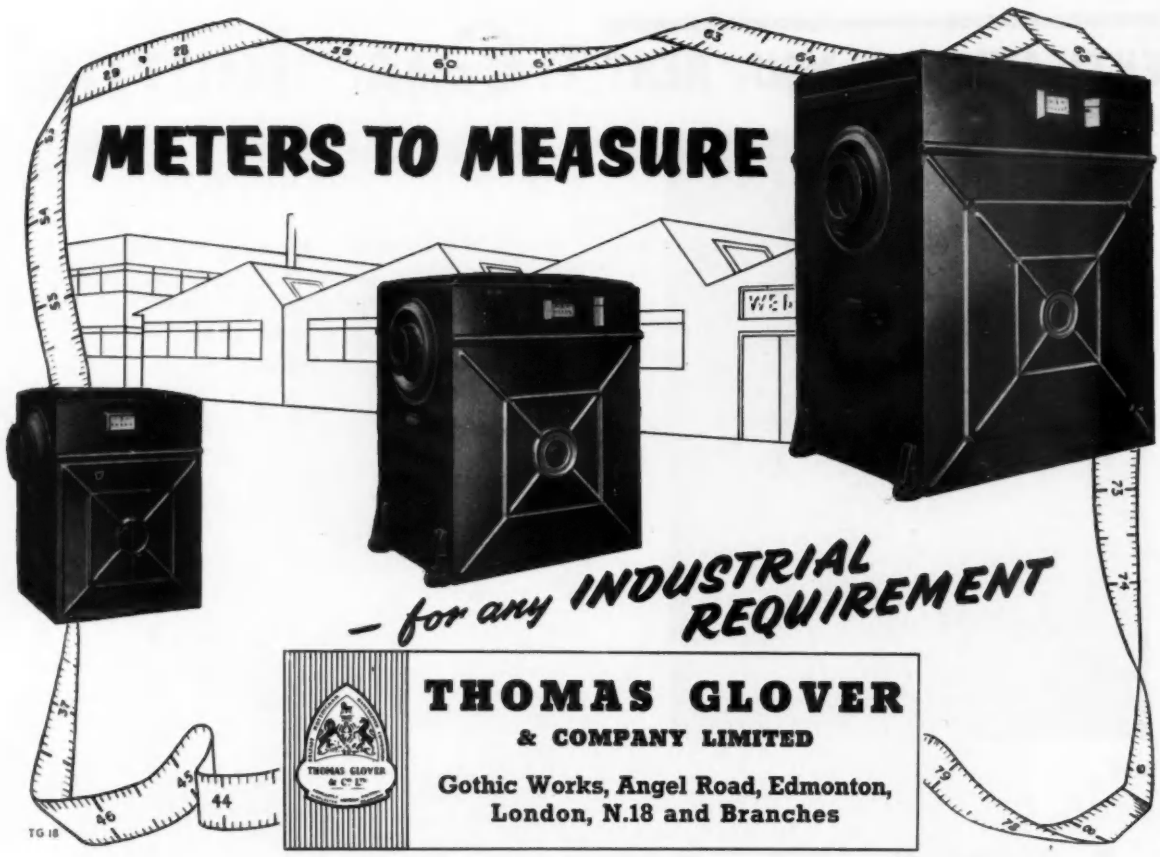

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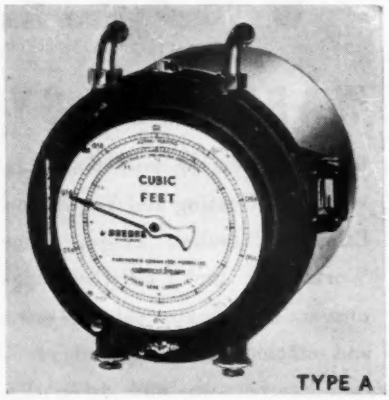

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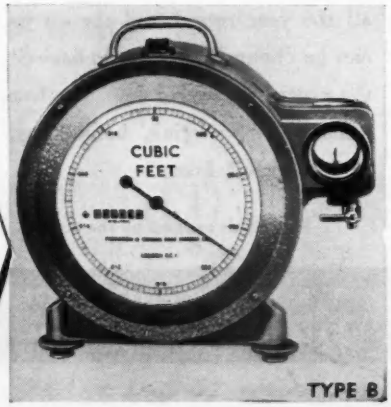

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INSTRUMENTATION NUMBER

Gas Journal

VOLUME 283. No. 4805. JULY 6, 1955. 107th YEAR

Instrumentation to the Rescue

THIS issue of the 'JOURNAL' is devoted almost entirely to the subject of instrumentation as it applies to the gas industry. The reason for our choosing this particular time to emphasize the significance of the subject will be clear to all those who have been able to visit the British Instrument Industries Exhibition now open at Earls Court in London. Instruments and their manufacture have become a major industry in this country, and a most progressive one at that, as can be appreciated from even the briefest survey of the bewildering variety of instruments on show at the exhibition. Ingenuity and skill can be seen here at their best in a selection of instruments ranging from the simple water-in-glass U-tube to the most complicated electronic devices. No process used in industry would appear to have been overlooked. Wherever an instrument could be devised to do a job more effectively, more quickly or with greater reliability, than a human operator, no effort has been spared to develop one and, in most cases, with spectacular success. It is clear, upon reflection, that the present high standard of productivity in this country would not have been possible had it not been for the invaluable aid given to industry by instruments of all kinds. In the face of ever-increasing labour costs and a shortage, particularly of skilled men, the industrialist has had to turn to the instrument manufacturer to help him solve the very difficult problem which confronted him. Nor has the instrument manufacturer failed him; to this the present exhibition bears witness.

The irresistible economic pressures which have forced other industries to adopt instrumentation and automatic control as an integral part of factory management have also affected the gas industry, which, today, finds itself more highly instrumented than ever before. Integration within the gas industry, a feature of the post-war period, has invariably led to fewer and larger manufacturing stations, interconnected with each other and with the consumers by elaborate grid systems, and there can be no doubt that this trend will continue and that, with it, will develop a new balance between the capital cost of plant and that of the labour required to operate and maintain it. With the price of coal and other materials required by the gas industry continually increasing, it is not possible today to consider the employment of a really generous labour force to run a works. With the exception of coal, labour is, in fact, the most expensive item in the industry's cost sheet and, in consequence, must be used as economically as possible. In this connection, it should be noted that labour is a continuing charge against production whereas instruments, once installed, soon pay for themselves and then involve only a small cost for running maintenance.

For very many years, instrumentation of a kind has been employed in the gas industry. Obviously, from the beginning, certain variables have had to be measured in order that satisfactory and continuous operation of plant should be possible, also in order that the processes of manufacture and distribution should be economically sound. Most of the instruments used for this purpose have been, however, of a very simple nature, water-in-glass pressure gauges and mercury-in-glass thermometers being perhaps the most important. Control of plant in such circumstances has involved frequent readings of numerous gauges and this, in turn, has called for the expenditure of many man-hours, man-hours which, today, cannot easily be found. In due course, a partial answer to this problem was obtained by the use of automatic recording instruments but, here again, these instruments could only record changes and trends in variables: they could not control them. The human intelligence was still required to correlate the trends and to apply the necessary remedial measures—hence the further development of completely automatic controls.

Nowadays it is possible for a large gasworks to be run with a small number of relatively skilled men, suitably situated at key control points. An ideal example of this appears at the Ponders End works of the Tottenham Division of the Eastern Gas Board where the application of instrumentation has been taken as far as is reasonably possible. When the works was designed, it was first considered 'how much plant one skilled man, given adequate instrumentation, could fairly control and then to dispose the plant around one central working position.' The fore-going quotation is taken from the Chairman's Address to the London and Southern Section of the Institution of Gas Engineers this year by Mr. E. O. Rose, Engineer of the Tottenham Division who, later in the same address, pointed out that

the Ponders End works, which produces 7 mill. cu.ft. of gas per day, employs, apart from the retort house and coke handling plant, only two shift men on the remainder of the plant! One of these men looks after exhausters, electric generators, detarrers, washers, tar and liquor, purifiers, benzole extraction and water pumping, while the other attends to gasholder operation, gas drying, gas boosters, compressors and makes and outputs. Another works which illustrates the versatility of instrumentation is that at Swan Village in the Birmingham Division of the West Midlands Gas Board. Here again the labour force required to run the 8½ mill. cu.ft. per day works is comparatively small, largely on account of the labour-equivalent of the instrumentation installed. It is true that the particular works cited were designed as whole units and that, in consequence, the overall plans permitted wider scope for instrumentation than is the case with established plant. Nevertheless it cannot be denied that suitable instruments and controls can make a valuable contribution to maximum efficiency in most cases, if judiciously applied.

Few subjects are so very widely discussed these days as 'automation' and the science of electronics upon which it is based; some people have been led by it to believe that the age of robots will soon be with us. Although this may seem a far-fetched idea and although it will be sometime before instruments can replace the human intelligence in all, or even most, of the operations which comprise our industrial and commercial activity, nevertheless there is a distinct tendency for instruments to play a rôle of ever-increasing importance. As far as the gas industry is concerned, two qualities have been considered essential in an instrument if it was to be of real value to the gas engineer. In the first place, it had to be robust so that it could withstand the conditions normally found in gasworks; secondly it had to be relatively simple in design so that there were not too many delicate parts to go wrong, and so that it did not need a great deal of attention. Consequently, electronic gear has been thought rather delicate for gasworks conditions. However, it is interesting to note that, already, electronic timers have found their way into the sacred precincts of the retort house for the purpose of controlling the coke extractors of continuous vertical retorts. Maybe the time is not so very far distant when the several operators in charge of sections of plant—as at Ponders End—will be replaced by one single technician at a central control point especially designed to house all the electronic and other instrumentation necessary for complete surveillance of all the works' processes.

On the distribution side there have already been great strides in the use of instrumentation, and in this issue we describe the remarkable control which can be exercised over extensive grids and networks. Here again, the savings in labour costs are very considerable, especially since remote holder stations and compression plants no longer need to be manned continually. Times have changed and, fortunately, the gas industry has changed with them. Clearly instrumentation has come, and come to stay. Already, in these challenging days, instrumentation has proved time and again its capacity to assist the gas engineer, whether in manufacture or distribution. It is in the interests of the gas industry to take advantage of every help which it can offer.

Fuel Prospect

EMPLOYEES of the North Western Gas Board are given an unusually good helping of food for thought in the latest issue of *Focus*, 'intended primarily for the information of the Board's own employees', whose Editor points out that its contents are not necessarily to be taken as being endorsed by the Board. An earlier issue dealt with 'Prosperity Prospect', and the interest aroused prompted a return to the contention that coal price control holds back smokeless fuel progress. The most obvious benefit to the gas industry from freedom in coal purchasing would be to relieve the industry from the threat of a cut in coal supplies by Government decision, and therefore from the need to use coke and oil for gas production, except in so far as this might prove to be at any given moment the most economic process. The extent to which the relative costs of the two processes would be altered under a free coke market would depend on the movement of coke prices and coke demand, but the ability to vary the proportion of the two types of gas is an advantage of decisive importance in attempting to compete with other fuels, though its value in terms of money cannot at present be assessed.

The new clean air policy presents the gas industry with what is not only an opportunity but a public duty —the promotion of sales of coke for domestic use. Freedom for coal supply would mean that the industry could assure the domestic consumer of continuity not only in the supply of coke throughout the winter period but also in the supply of specific grades appropriate for use in particular appliances. Without the assurance of continuity in the supply of the requisite grades of carbonizing coals, which can only be obtained in a free market, this would be impossible. After examining the probable rise in the price of better-grade carbonizing coals if price controls were abolished, *Focus* asks what would be the effect on the competitive position of coke as against other fuels. The answer depends on the prospect for changes in the price of coke, and here the decisive factor is the higher efficiency of coke as opposed to coal burning.

Under present conditions of controlled coke prices, the ratio of coke to coal prices bears no relation to the relative efficiencies of the two fuels. Coke sold at 5s. 6d. per ton more than coal is in effect suplied at 77s. less than coal on the basis of price per ton for useful heat actually supplied, where both are used on an improved modern grate. The price of manufactured fuel for use in improved domestic open grates should be one-third higher than the price of domestic coal. In practice the level of realized price actually achieved will depend on the quality and general burning characteristics of the coke supplied and on the efficiency of the service of the sales organization, all of which will influence the choice of consumers between a ton of useful heat in the form of coal and a ton of useful heat in the form of coke, similarly priced.

Turning to the world fuel picture, *Focus* sees strong indications that increasing use of atomic energy, oil, and natural gas may bring about a long-term fall in world coal prices. In that event the greatest benefit from coal price freedom in Great Britain, which would be accompanied by freedom to import fuel from abroad, would be the improved alignment of the trend of coal

prices in Britain with the downward trend of world prices; but even short of that favourable possibility coal consumers are bound to find their charges enormously simplified when coal prices in Britain move in line with some predictable trend, rather than in a series of unpredictable upward jerks. The Beaver Report suggests that the gas industry should in 10 years carbonize an additional 10 mill. tons of coal, allowing the industry to sell another 5½ mill. tons of coke (the present total being about 11 mill. tons) and to raise gas sales from 2,500 mill. therms to 3,300 mill. therms. The additional coke, together with half the increase in gas sales, would be sufficient to replace 10 mill. tons of bituminous coal at present burnt in domestic grates in the worst affected smoke pollution areas. The projected rise in total gas sales of some 32% over the decade, or 3% annually, which could be achieved with this increased tonnage of coal carbonized, would appear to be sufficient also to meet the probable rise in demand from other consumers. The review concludes: 'There is some considerable evidence for the view that this country is in fact on the threshold of a period of economic expansion and growing economic freedom, and that the gas industry can best make use of the opportunities presented by these changes by grasping the nettle of coal price freedom.'

Flow of Information

SCIENTIFIC discoveries are not being effectively communicated to industry because the psychological needs of the industrial reader are not sufficiently appreciated. Such is the view expressed by Professor G. Patrick Meredith in a paper on 'The Flow of Information' summarized in the current issue of the National Institute of Industrial Psychology's quarterly *Occupational Psychology*. As a result of prolonged investigation Professor Meredith draws the conclusion that while the research worker must certainly write a report on his work his report should not, as it stands, constitute the communication to the industrial reader; a go-between is indicated; an act of translation is required. The man in the laboratory is, in outlook, in training, and in mode of life, a very different person from the man in the factory. Their problems, their languages, and their values are different. It might be thought a pity that the two have to get involved with each other at all, yet each presupposes the other. Investigators have been welcomed with cordiality, but there is a clear indication that over a wide area science is failing to make its significance felt in industry.

Engineers, managers, directors, and others who have to read scientific reports, says Professor Meredith, complain about scientific jargon, indigestible prose, ponderous style, confusing diagrams, incomprehensible formulæ, and so on. In his investigations he found that not only the technical documents themselves but their context in the whole field of communications was important. The understanding of a scientific document, he says, depends not only on its intrinsic clarity, but also on the willingness of the reader to understand. This in turn depends on his appreciation of the consequences of understanding in the shape of an ensuing change of practice. If there is a resistance to change, there will be an unwillingness to understand or even to read. The most important of the arts of communication is persuading the reader that what is said matters to him.

Professor Meredith suggests that a technical document is not a self-sufficient medium for the communication of scientific knowledge. As well as words, adequate communication needs diagrams, pictures, films and, above all, direct demonstration by the human operator. A new human agent must be introduced—a communications officer who would spend his time in laboratories and factories. He would answer questions about documents and recommend films, suggest visits to experimental plants, and organize demonstrations. He would take a hand in writing documents, choosing illustrations and designing diagrams. He would act as the human link between the man in the laboratory and the man in the factory. This new technological era demands a new means of communication and, as new demands are made upon man's understanding, the role of human interpreter becomes more important than ever before.

GAS SEARCH IN WALES

THE search for natural gas in Great Britain is being extended to north eastern Wales. The new area to be surveyed will be dealt with, at any rate initially, by the gravity method. This consists of recording variations in the force of gravity caused by the location of the denser types of rock nearer to or farther from the surface. The instrument used, the gravimeter, is in principle no more than a spring balance, but it is so sensitive that it can record variations as minute as one in 100 mill. The region is known to geologists as the Cheshire basin, and stretches from the southern part of Lancashire through Cheshire and Shropshire touching the Welsh counties of Flint and Denbighshire. According to a writer in the latest issue of *Industrial Wales* the best prospects here are thought to be in the carboniferous system, rocks about 220 to 280 mill. years old, of which there are in all some 3,000 sq. miles in this area. The licences recently granted to enable exploration to proceed, in accordance with the Petroleum Production Act of 1934, cover 956 sq. miles. It depends on the result of this initial gravity survey whether seismic work or deep drilling is to follow, or whether further areas will require to be investigated.

Should success be attained, exploitation of the gas is simple and unobtrusive. Once a producing well has been completed, the derrick and drilling equipment are removed, disturbance of the surrounding land is made good, and only a small arrangement of valves, occupying a few square feet, with a buried pipeline, remain to mark the spot.

NATIONAL SAVINGS

Figures issued by the National Savings Committee show that at the end of March over 902,000 workers in nationalised industries, the civil service, and local government were saving regularly through more than 13,350 groups. Group membership increased by 47,072 in six months. Local authorities groups total more than 3,340, with a membership of 121,657, representing an increase of over 10,200 in six months. Group membership and total number of groups for the various nationalised industries include: National Coal Board, 227,769 (1,012); railways, including hotels and restaurants, 60,622 (2,017); road transport (passenger), 43,706 (337), London Transport, 33,343 (36); road haulage, 6,515 (239); Central Electricity Authority, 39,268 (609); Gas Council and area boards, 25,396 (507); airways, 1,580 (14); National Dock Labour Board, 7,423 (35). Figures for the health services are 43,263 group members and 1,289 groups.

Personal Notes

MR. A. MACGILL MACPHERSON, Manager of the Cupar undertaking of the Scottish Gas Board, has been appointed President of the Cupar Rotary Club.

MR. R. E. G. WEDDELL, Joint Managing Director of W. G. Allen & Sons (Tipton), Ltd., has been elected President of the Institute of Welding for 1955-56. SIR CHARLES LILLICRAP, former Director of Naval Construction, has been elected Vice-President.

MR. R. K. LAW has been appointed by the North Thames Gas Board as Senior Assistant Engineer, Fulham Works. MR. F. H. NEWSOME has been appointed Senior Draughtsman at the distribution drawing office, and MR. G. H. PEACOCK has been appointed Station Accountant at Hornsey.

MR. W. D. WILSON, Chairman and Managing Director of George Wilson Gas Meters, Ltd., has been elected for a second term as President of the Warwickshire Rugby Football Union. Mr. Wilson is an old player and the present Secretary of the Coventry Club. He also played for the Warwickshire County XV in the early 1930's.

MR. ERNEST M. MYERS, Durham Divisional Coal Preparation Engineer for the National Coal Board, has retired after 50 years in the mining, coking, and by-product industries. Mr. Myers has served as President of the Coke Oven Managers' Association, and Chairman, Vice-Chairman and Secretary of the Society of Chemical Industry.

MR. DOUGLAS C. DOW, Production Engineer at Alloa gasworks, and MISS C. R. M. JEFFREY, a member of the gas showroom staff, were married at Alloa. A dinner service was presented to the couple by the staff and employees, Mr. W. M. Gledhill, the Group Manager, handing over the gift.

The EARL OF HALSBURY, MR. KEITH MURRAY, MR. PERCY E. DAW, and MR. LESLIE H. HARDERN will again comprise the jury for the domestic gas appliances section of the Royal Society of Arts industrial art bursaries competition for 1955. Competitors in the section will be asked to submit three designs, showing perspective and typical working details. The closing date for entries is October 10.

CAPTAIN E. O. F. PRICE, R.N. (Ret.) has been appointed London Area Manager of Richard Sutcliffe, Ltd. In the past, most of the Company's business has been with the mining industry, but in recent years an increasing number of orders has been received from heavy industry. The headquarters of many of these industrial concerns, together with those of the nationalised industries, are in London, and with this in mind, Captain Price will administer the London area, including the Home Counties and Southern England, from 235, Vauxhall Bridge Road, S.W.1.

MR. E. JACKSON has been elected Hon. Secretary of the Cumberland and Westmorland Gas Managers' Association in succession to MR. W. B. HETHERINGTON, who has retired. The Chairman for 1955-56 is MR. A. R. CROFT (Carlisle), who is at present ill. MR. S. SMITH (Penrith) who has been elected Vice-President, is carrying out the presidential duties during Mr. Croft's absence. The Hon. Secretary's address is 67, Lowther Street, Whitehaven.

MR. S. J. CLIFTON, M.INST.F., a senior sales executive of George Kent, Ltd., left for Malaya by air on June 23, on the first stage of a tour of overseas markets. After a few days in Malaya he will proceed to Sydney, Australia, where he will work with the Kent New South Wales branch company, Davies-Kent Pty., Ltd.; and later with George Kent (Victoria) Pty., Ltd., in Melbourne. He will also spend time in Adelaide and Brisbane with the Kent agents, Pascoe & Co., Ltd., and Underhill, Day & Co. Pty., Ltd. On leaving Australia he will fly to Vancouver, B.C., for further negotiations, thence to Toronto for meetings with executives of Kent-Norlantic, Ltd., the Kent branch company in Canada, and so home to England.

PROFESSOR W. R. HAWTHORNE, Chairman of the Fuel Research Board, has been appointed by the Minister of Fuel and Power to be a member of his Scientific Advisory Council. He has been Professor of Applied Thermodynamics, University of Cambridge, since 1951. He was educated at Westminster School, Trinity College, Cambridge, and Massachusetts Institute of Technology. He was formerly Associate Professor of Mechanical Engineering, 1946, and George Westinghouse Professor of Mechanical Engineering, 1948, at the Massachusetts Institute of Technology. He was awarded the Medal of Freedom (U.S.) in 1947.

MR. R. J. GLINN has retired after 44 years with Babcock & Wilcox, Ltd. He has also retired from the Board of the Calorizing Corporation, of which he has been a Director since 1928. Mr. Glinn joined Babcock & Wilcox as a student apprentice at Renfrew in 1911; subsequently obtaining experience in London and at the Oberhausen works of the Deutsche Babcock & Wilcox, Dampfkesselwerke A.G. He returned to Babcock & Wilcox in 1919, remaining until his retirement. Mr. Glinn has been a M.I.MECH.E. since 1915, during which period he has given two papers and served on the Council. He was a member of the Admiralty Committee on Boiler Corrosion, and of the Industrial Water Committee of Investigation set up by the British Iron and Steel Research Association. He has also served on a number of committees of the British Standards Institution.

SIR HAROLD WEST has intimated his intention to retire from his position as Managing Director of Newton, Chambers & Co., Ltd., in the spring of 1956. MR. P. J. C. BOVILL, an Assistant Managing Director and General Manager of the Chemicals Division, has been appointed a member of the Board with a view to his taking over the duties of Managing Director when Sir Harold's retirement takes effect. Sir Harold West has been associated with the Company since 1919 and has been Managing Director since 1941 and Vice-Chairman since 1953.

Calendar & Directory Alterations

The following changes have been notified during the past month. To keep the information in the current 1955 edition of the GAS JOURNAL CALENDAR AND DIRECTORY up to date readers are invited to note these alterations in the Directory Section.

Page D75.—SOUTH EASTERN GAS BOARD: Delete A. Dalgleish, *Member*, retired.

Page D77.—METROPOLITAN DIVISION, SOUTH EASTERN DISTRICT: W. H. Carder, *District M.*, vice A. S. Chandler. WEST SURREY DIVISION: A. H. Savill, *Divisional E.*, vice R. M. Farror.

Page D141.—INSTITUTION OF GAS ENGINEERS: See 'JOURNAL' of June 8, p. 681, for full list of officers for 1955-56.

Page D147.—NORTH OF ENGLAND SECTION: K. E. B. Brown (Newcastle), *Hon. Secretary*, vice F. J. Webster.

Page D152.—AFFILIATED ASSOCIATIONS: Cumberland and Westmorland Gas Managers' Association; A. R. Croft, *Chairman*, E. Jackson, *Hon. Secretary*, 67, Lowther Street, Whitehaven, Cumberland.

Page D153.—LONDON JUNIORS: N. R. Junkison, *President*, vice E. W. B. Dunning; J. B. McKean, *Senior Vice-President*; J. E. Gray, *Junior Vice-President*.

Page D157.—SOCIETY OF BRITISH GAS INDUSTRIES: Sir Hugh Beaver, *President*, vice Sir Ernest Smith; Colonel W. E. Gibbons, *Chairman*, vice J. Simpson; F. P. S. Stammers, *Vice-Chairman*; W. D. King, *Hon. Sec. Elective Members:* W. H. G. Roach, S. J. Beale, Colonel W. R. Glover, J. Simpson.

Page D158.—GAS OFFICERS GUILD: E. O. Rose, *Chairman*, vice J. F. Rust; S. H. Stokes, *Vice-Chairman*.

Page D159.—WOMEN'S GAS FEDERATION: Mrs. G. Abbott, *Chairman*, vice Dame Vera Laughton Mathews.

The Central Instrument Section of the South Eastern Gas Board.

Functions of an Instrument Department

INSTALLATION and maintenance of process instruments is dealt with in the South Eastern Gas Board by a Central Instrument Section which deals also with official gas testing matters. Work on process instruments can be subdivided into the following:—

Installation.
Instrument maintenance.
Repair and re-standardization work.
Training.
Development work.

Installation

Some standardization is arising because the Section either specifies or approves the choice of all new instruments and their installation details. Actual installation is carried out either by local labour or by contractors, but all new installations are either put to work or examined by the Section.

Instrument Maintenance

A preventive system of maintenance is being set up, regular daily, weekly and monthly routine work being carried out on each instrument. Only small numbers of semi-skilled, local men are required, complete overhauls being carried out at six-monthly or twelve-monthly intervals by members of the Section.

In many cases an instrument can be replaced by a 'spare' and then repaired in the workshop. Comparatively small numbers of spare instruments are required for, if the overhaul of a certain type of instrument requires a full week's work and there are five hundred of these instruments in the Area, then the provision of ten spares, at an increased capital cost of only 2%, enables all these instruments to be repaired in the workshop. At the Section the programme is planned, brochures giving details of the routine site work are prepared, and the semi-skilled personnel are trained.

Preventive maintenance methods (weekly cleaning, three-monthly overhauls and adequate spares) have already been applied to the Fairweather recording calorimeters used for official gas testing. The loss of recorded time is now less than 5%, which indicates the desirability of the application of such methods to all instruments used in process work.

Instrument Repair and Re-standardization Work

This work is carried out for three distinct reasons:—
(1) Instruments are returned from the works when their per-

Fig. 1. A corner of the instrument stores.

D

Fig. 2. Machine shop and rough workshop.

formance has become unsatisfactory for any reason at all.

(2) Instruments are repaired to go into the instrument stores (Fig. 1) for subsequent substitution with works instruments.

(3) New instruments purchased through the Section are examined and checked before issue.

Calibration certificates are issued for all repaired instruments the work being done by skilled staff. A complete set of standards, ensuring consistency throughout the area, and machine shop facilities (Fig. 2), are available, and the area appliance workshops can be used for turning, paint spraying, etc.

For convenience instruments are sub-divided according to the variables they are used to measure.

Pressure. The re-calibration of most pressure equipment requires standard instruments, those used being mounted on a panel. (Fig. 3.) A micromanometer for the range of 0-4 in. W.G., a water-filled U-gauge for the range 0-100 in. W.G., and a 'dead-weight' tester for the range 0-1,000 lb. per sq. in., are available.

Flow. Orifice plate dimensions are checked by means of a standard internal micrometer and the differential pressure devices are re-calibrated against the pressure standards already described. Such checks are essential to ensure that deposits have not built up in the orifices or pressure devices, thus producing conditions other than those for which the instrument was calibrated.

An air duct (Fig. 4) and a water system (Fig. 5) are available for recalibrating steam or air meters, and liquid meters respectively. The standard in each case is an orifice plate installation of the conventional type.

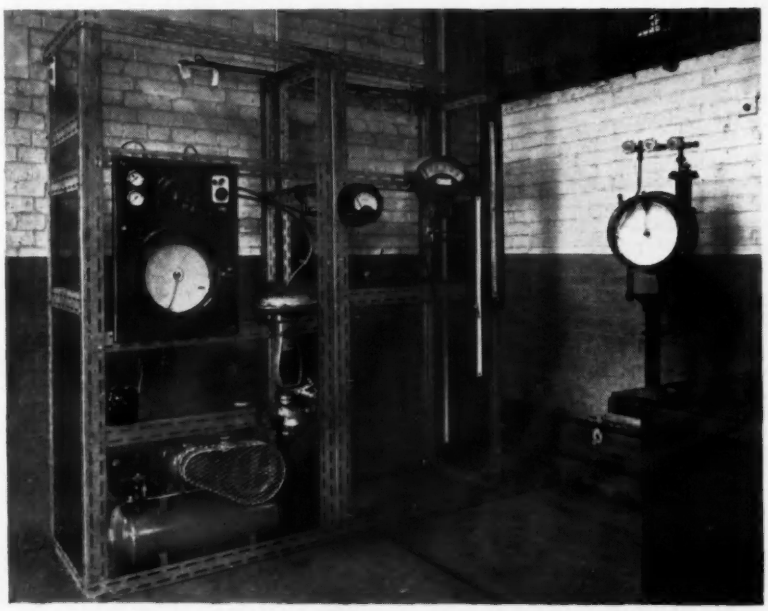

Fig. 3. Panel used to mount instruments for test purposes.

Temperature. Chromel-alumel wire is now standard for thermocouple equipment used in the range 600-1,000°C. Samples of the wire are checked at the National Physical Laboratory and the electrical measuring instruments are checked against 'workshops' potentiometers, themselves re-standardized against a Cambridge 'Vernier' potentiometer.

Temperature measurement up to 1,500°C. is carried out by means of disappearing filament pyrometers. Two tungsten strip lamps which have been calibrated at the National Physical Laboratory are used as standards and a third lamp, itself re-calibrated against a standard once every 12 months, is available for general use. (Fig. 6.)

Additional sub-standard strip lamps are used for checking the optical pyrometers in use, all pyrometers found to be in error by more than 15°C. being returned for repair. In all, since vesting day, some 500 optical pyrometers have been repaired.

Calorific Value.—Mercury in glass thermometers and gas meters are used in both the Boys' non-recording equipment

Fig. 4. Installation for recalibration of air or steam meters.

Fig. 5. Installation for recalibration of water or oil meters.

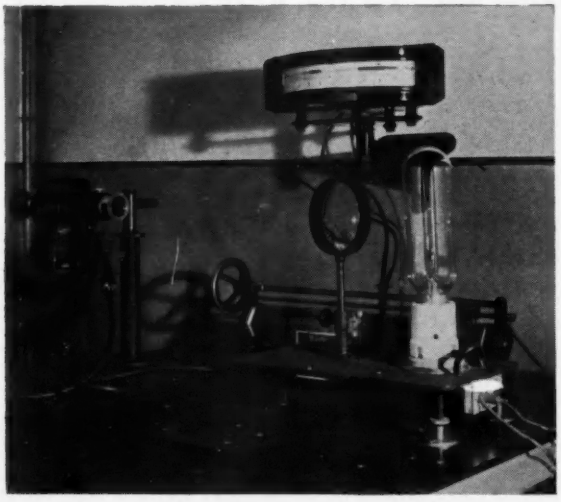

Fig. 6. Equipment for calibrating disappearing filament optical pyrometers.

and the Fairweather recording calorimeter. The water bath used enables ten mercury in glass thermometers to be calibrated simultaneously against an N.P.L. standard.

Gas meters are re-checked against a displacement meter prover of the 'Hyde' pattern which enables exactly one cubic foot of air to be displaced through the meter. The pressure drop across the meter can be checked and provision is made to bring the temperature of an escapement meter and the bath to equality.

Resistance boxes are used to recalibrate the electrical recorders used in conjunction with the Fairweather recording calorimeter. A standard Fairweather recording calorimeter is continuously running and can be used to measure either district gas or the gas from a small holder in which test mixtures can be provided. Hence the re-calibration of inferential calorimeters can be carried out.

Specific Gravity. A standard recording gravitometer, which can be checked by direct weighing, is available, and used with the test holder enables any specific gravity device to be re-calibrated. A standard gravitometer fitted with an electrical transmitter is shown in Fig. 7.

Training

Skilled instrument staff can be trained only by a lengthy programme of work in an instrument section under supervision. The semi-skilled staff, however, are required to carry out duties described in specially prepared brochures. To assist in the use of these brochures a training course is carried on. This course has, as its aim, the provision of a background of

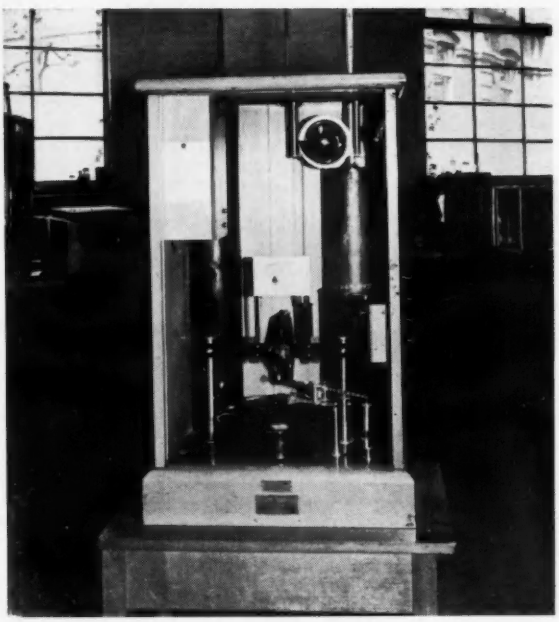

Fig. 7. Specific gravity recorder with 'Elliott' Shotter transmitter for distant recording.

instrumentation in general, and detailed instruction in the duties to be undertaken by the Board's instrument technicians.

The course lasts for a period of three months, the background being supplied by a series of lectures. Practical work is carried out on aspects of instrumentation which will be of major importance and, as far as possible, all the duties which will have to be carried out are included. If many instruments of the same manufacture are likely to be encountered then the course concludes with two weeks' instruction at the manufacturer's works.

Development Work

Problems which arise can frequently be solved by new application of commercial instruments, alone or in combination, but when this is not possible it is necessary to design a new instrument. Both methods have been applied in the development work which has been undertaken since vesting day by the Instrument Section of the South Eastern Board.

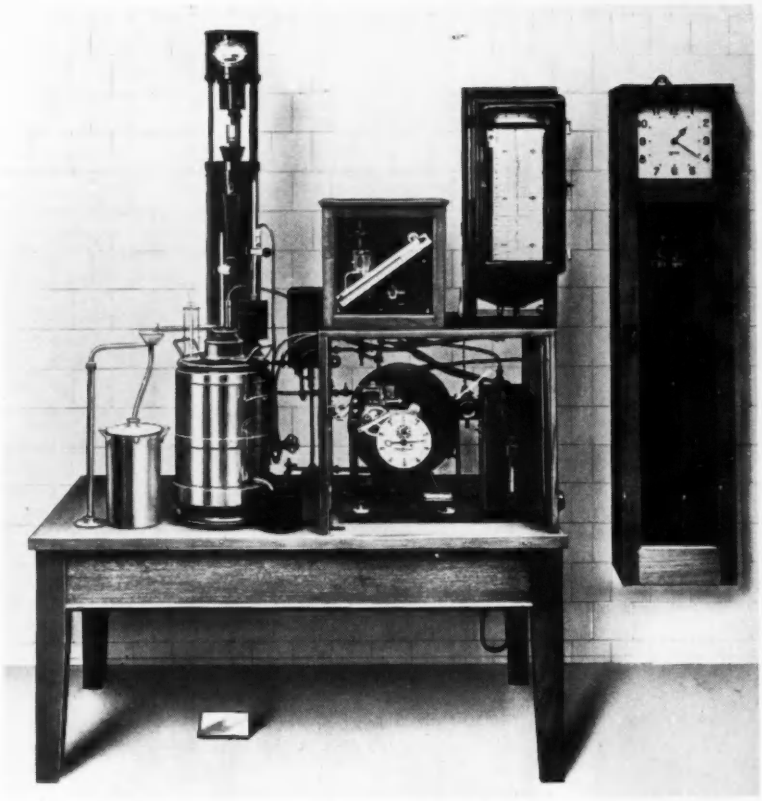

Fig. 8. Modified form of Fairweather recording calorimeter.

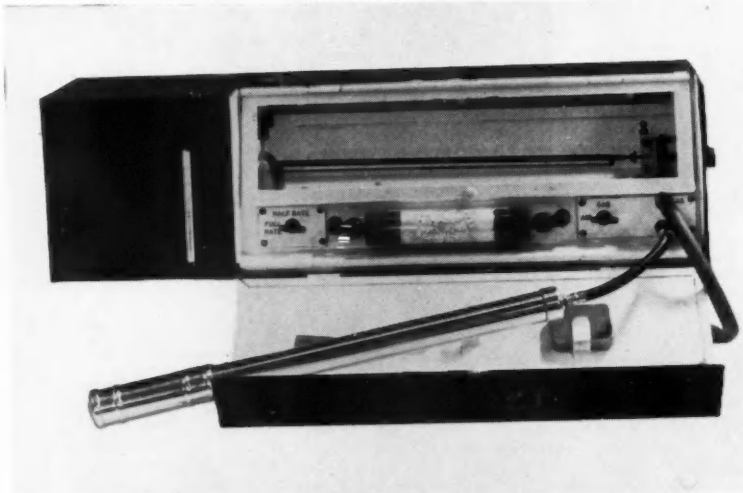

Fig. 9. Modified form of Hales and Moss specific gravity balance.

The Modified Fairweather Recording Calorimeter

This work, undertaken in conjunction with Scientific and Projections, Ltd., has led to the substitution, for the tabular compensator, of a smaller, aerothometer device. Details have already been given[1], the modified instrument being illustrated. (Fig. 8).

Automatic Control of Calorific Value.

After extensive tests[2] a combination of commercially available recording calorimeter and pneumatic controller was found which has proved completely satisfactory and is in use at several works.

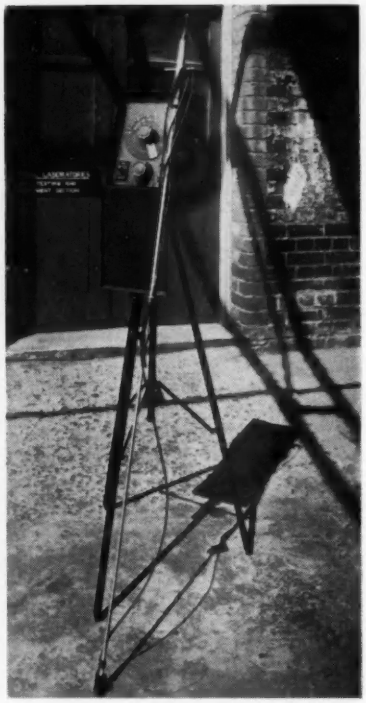

Fig. 10. Hot wire anemometer developed for determining flow in distribution mains.

Specific Gravity Balance

A laboratory instrument was modified to make it robust and portable[4]. (Fig. 9.) About 30 of these instruments are now in use in various works.

Hot Wire Anemometer

Already fully described[3], the instrument can successfully be used to measure gas flows in the velocity range 5-40 ft. per sec. No permanent pressure loss is caused, but for high accuracy the instrument must be calibrated on the gas under test. The design is robust, portable and self-contained, a ½ in. B.S.P. hole tapped in the main being the only fitting necessary. (Fig. 10.)

Since the instrument has been available there have been further applications in connection with various industrial air flow measurements. Under these conditions very good stability is obtained, and the results are consistent within ±2%. For both air and gas applications a recording instrument is available.

At present experiments are proceeding to investigate the performance of pressure difference devices of novel types—*viz.*, multiple venturis and aerofoils, but this work is as yet only in the early experimental stage.

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G. C. Farmer. 'Calorific Value Control in the Gas Industry' *Instrument Engineer*, Vol. 1, No. 3, April, 1953.

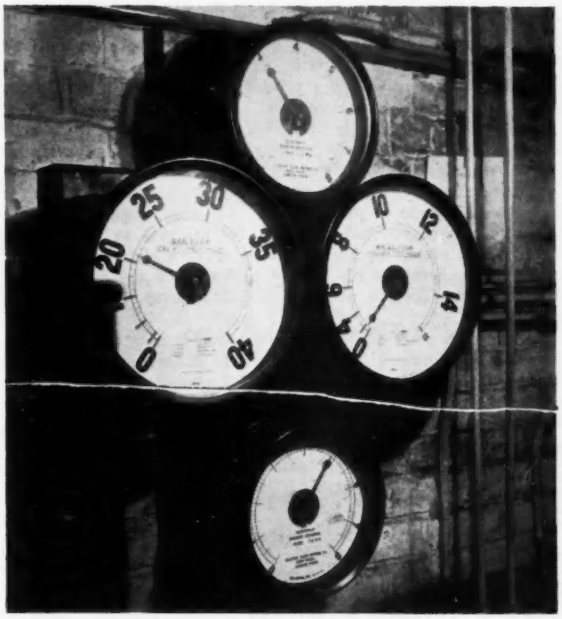
3 J. S. Hales and W. C. Moss. 'A Gas Specific Gravity Balance'. *J. Sci. Insts. No. 10*, 309-317.

4 J. R. Kenward and T. A. Lucas. 'Accurate Determination of Specific Gravity of Town Gas'. GAS JOURNAL, 1953. 273, 445, 446.

Instrumentation and the Gas Industry

PART 1

In this series, A. Linford, B.SC., A.M.I.C.E., and G. C. Farmer, ASSOC.M.INST.GAS E., describe the development of instrumentation in the gas industry, the theoretical considerations underlying the design of instruments and also the practical aspects of their operation and maintenance.



Early type of electrical gas flow meter at Harrington coking plant.

MEASURING instruments and automatic controllers are playing a rôle of ever increasing importance in industry and in the life of the nation as a whole, and within the last decade there has been a phenomenal expansion in the application of instrumentation to industrial processes.

There is a close analogy between measuring instruments and store-keeping systems. Both serve the purpose of maintaining a check on the use of raw materials and the prevention of the waste of these. However, it is only within recent years that responsible quarters have begun to fully appreciate that, without the measurement of all the significant variables involved in the manufacture of the final product, whatever this may be, from the raw material, large and unsuspected losses can persist over long periods. Without measurement, the only means available of ascertaining whether preventable waste is taking place is by guesswork or intuition. Measuring instruments also perform the invaluable service of enabling the improvements, or otherwise, of changes in processing techniques to be evaluated on a scientific basis.

The gas industry, particularly, should be fully conscious of the vital importance of conserving its raw material, coal, especially since there is an ever widening gap between coal production and coal consumption. It is unlikely that large deposits of natural gas will be found in this country, and even the construction of nuclear power stations will do little towards relieving the critical coal situation in the foreseeable future. This shortage, coupled with rising labour costs, will have the inevitable result of ensuring a steady rise in the price of coal for many years to come.

The logical development of measurement is to utilize this for automatic control purposes; no controller, however simple, can function without measurement, whether an outward indication of this measurement is apparent or not. There is overwhelming evidence to show that if automatic control equipment is properly applied and correctly 'tuned', it will do the job allocated to it more efficiently than a human operator. At all times, the automatic controller gives its undivided attention to the process under control, and makes the necessary adjustments to the plant with mathematical precision. Apart from ensuring more steady conditions, the effect of automatic control is to release labour for other duties. This particular factor is one of growing significance; there are no indications whatsoever that the labour situation will be eased in the future—in fact, the reverse will probably be the case. Therefore, it is becoming increasingly important in all industries to reduce the labour force required per unit of production. At the same time, there is a continuous pressure on industry to produce more goods of a better quality at a lower price in order to maintain the vital export trade. In this field, the gas industry indirectly plays a rôle of no little importance—in places as much as 40 to 50% of gas output is used by industrial consumers.

The gas industry was among the pioneers of the continuous process—the accepted basis of sound chemical engineering. It was also a pioneer in the field of measurement and automatic control. However, at the present time, there is no doubt that the oil industry is in advance of all others in the application of instrumentation to industrial processes. In fact, in the oil industry, some processes have become so complex that automatic control becomes imperative. In this connection, it is interesting to note that it has been stated on good authority that, as a result of comprehensive instrumentation coupled, of course, with good management, in spite of the rise in price of raw materials, plant and labour, there has been virtually no increase in the cost of production of petroleum products; the increase in price to the consumer is due to the incidence of taxation. Recent trends in the gas industry towards the wider use of measuring and automatic control equipment clearly indicates that the time is not far distant when comprehensive instrumentation will be the rule rather than the exception.

EARLY INSTRUMENTATION

The fundamental requirement of any industry manufacturing a product is a sound accounting system, and the basis of payment by customers of the gas industry, in final terms, resolves itself into the measurement of gas volume. In other words, from the very inception of the idea of selling gas to a large number of individual consumers, the measurement of gas was one of the essential requirements.

As early as The Sale of Gas Act, 1859, considerable trouble was taken to safeguard the consumer in respect of payment made for gas consumed, and provision was made for official inspection and testing of meters and the affixing of an official stamp. It was recognized that a perfect machine, either for the measurement of gas or for any other purpose, was an unattainable goal, the difficulties of the problem being increased by the fact that an inexpensive form of meter was necessary, which would give a counter reading of the volume of gas used, require little or no maintenance, and have a long working life. The Act, therefore, allowed a certain well-defined variation from absolute accuracy to the extent of 2 percentum in favour of the seller and 3 percentum in favour of the consumer. These tolerances for the consumers' meters apply to date.

In spite of the vast technological advances made since the latter half of the 19th century, it is interesting to note that the early diaphragm gas meters were, in fact, similar in design to the domestic meters now being produced, although of somewhat larger construction. The meters, of the 'dry' form, usually followed a general design of a sheet iron or steel box divided horizontally by a valve plate into two main chambers, the body being divided into two compartments by a diaphragm plate. Attached to either side of the diaphragm plate were leather diaphragms. Lateral movement of the diaphragms, resulting from their inflation and deflation by the gas in its passage through the meter, operated linkage-moving slide valves controlling the direction of flow in and out of the bellows, so producing a rotary movement to actuate the counting mechanisms.

Although a number of more complex designs of gas meter have been introduced from time to time, no meter has yet been produced to give a higher degree of accuracy for the cost of manufacture involved. Recent attempts at departure from the old basic design, including the use of plastic diaphragms, has not proved economically successful.

Next to volume measurement, an essential requirement, for obvious reasons, was that of gas pressure, both on the gas manufacturing and distribution sides, and consequently pressure gauges and registers, *i.e.*, recorders, were developed for dealing with the low pressures, equivalent to a few inches water gauge, which were involved. These instruments, also, are worthy of some comment, since, in basic principle, they are identical with the instruments used to this day, and in many respects the excellence of the design has not been surpassed.

Two general types of pressure measuring instruments were evolved, these being the 'dry' and the 'wet'. Substantially, the dry type class of instrument utilized a corrugated metallic diaphragm which deflected according to the pressure applied to it. The design, in fact, was the forerunner of the modern 'capsule' type pressure sensitive element, as used in an aneroid barometer. A typical example of one of these early instruments is the Hohmann and Maurer's aneroid gauge.

The wet type class of instrument also adopted principles which are widely used in modern measuring equipment. For example, the famous King's gauge utilized the elementary liquid-filled 'U' tube system. The gas pressure was applied to one chamber of the 'U' tube assembly, this chamber being sealed, while the other chamber, open to the atmosphere, contained a float which rode on the surface of the water with which the 'U' tube was filled. Change in gas pressure resulted in a change in water level which was sensed by the float, the float movement actuating the pressure indicating gear.

Another well-known pressure measuring instrument is Thorp's Register, *i.e.*, recorder. In this instrument the lower portion of a cylindrical float chamber is contained within a sealed tank. The lower portion of the float chamber is in communication with the interior of the sealed tank, while the upper portion projects above the tank cover and is open to the atmosphere. Therefore, in effect, a 'U' tube is formed, one of the limbs of this being the annular space between the wall of the float chamber and the wall of the tank. This assembly is partly filled with water and the gas pressure to be measured is applied to the interior of the sealed tank above the water surface. An increase in gas pressure causes the water level to rise in the float chamber, and this change is sensed by the float which is coupled to a pen for recording the change in level, in terms of pressure, on a chart. The cross-sectional areas of the tank and float chamber are so proportioned that the rise in water level in the float chamber is very much larger than that of the fall in level in the annular chamber, *i.e.*, the cross-sectional area of the annular space is large in comparison with the cross-sectional area of the float chamber. For example, a change in pressure equivalent to 1 in. W.G. would result in a float movement of say $\frac{7}{8}$ in.

In the early days of the gas industry, the purpose of the final product was to produce illumination, and therefore the most important standard was that relating to its illuminating power, and not its calorific value. Considerable difficulty was experienced in obtaining a standard source of light and in making an accurate comparison between this and the light given by a gas burner. In Britain, the standard of light adopted was the sperm candle, the Metropolis Gas Act, 1860, specifying this standard as 'a sperm candle of six to the pound, each burning 120 grains per hour'. For scientific purposes at least, this standard is not a particularly good one—the illuminating power varies with the condition of the atmosphere and candles differ slightly one from another. A more realiable standard is the Harcourt pentane lamp in which air is drawn over pentane liquid, which is burnt in a standard burner with a flame of definite height, corrections being made for atmospheric conditions. The International candle power is defined as the illuminating power equal to one tenth of that of the Harcourt pentane lamp.

In the early days of photometry, the familiar greased 'disc' was used as the indicator of the opposed lights, *e.g.*, the Bunsen or Leeson ('star') disc in the 'Imperial' photometer. Under modern conditions, of course, an advanced optical system would be used as, for example, the Lummer-Brodhan photometer, with a milk white screen instead of a grease spot, but the principle remains unaltered.

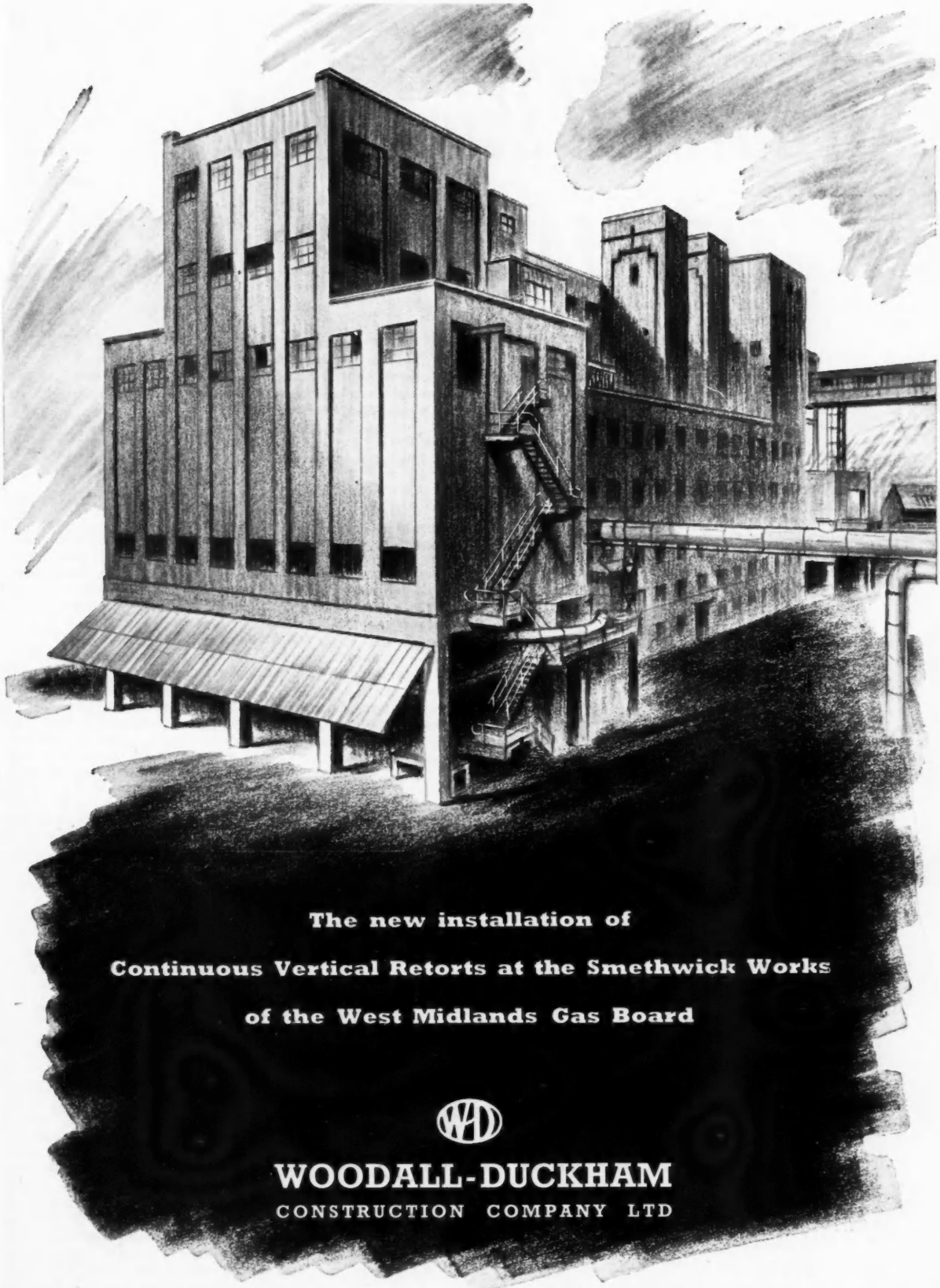
An instrument problem arising from gas-testing-photometry was the vital necessity of both accurately measuring and controlling the volume of gas used. The equipment devised consisted of the 'initial governor', the 'experimental meter' and the 'balance governor'. The initial governor consisted of a small gasholder, being a bell floating on mercury. The gas entered the space in the bell above the mercury, the inlet arrangements consisting of an orifice throttled by a shaped plug, carried by the bell, in such a manner that a rise in the bell caused the orifice to close and reduce the flow of gas, and vice versa. This formed an effective, yet simple pressure controller, the gas pressure being determined by the load required to support the bell. The initial governor was not an essential requirement, but on the other hand it was most desirable to ensure a constant pressure gas supply to the experimental meter, which otherwise might be exposed to a variation of pressure equivalent to several in. W.G.

In view of the high degree of accuracy required in the measurement of the flow of gas, a 'wet' type meter of the 'positive' displacement form was essential for conducting official tests. A typical meter of this description utilized a measuring drum divided into four separate longitudinal compartments, the dividing partitions being in the form of a four-bladed archemedian screw. The measuring drum, mounted on a horizontal axis, was contained in a sealed chamber partly filled with water to such a level that two compartments of the drum were always above the water line, gas charging one and discharging from the other. Gas flowing through the chamber imparted a rotary motion to the measuring drum, the known volume displaced by each compartment causing one quarter of a revolution of the measuring drum. An essential feature, of course, was the accurate setting of the water level. The maximum head loss across a meter of this description did not exceed 0.2 in. W.G. The basic principle of operation will be recognized as being identical with that of the station gas meter as used to this day.

The balance governor was a more delicate design of the initial governor, *i.e.*, it consisted of a bell floating in water with means for changing the desired gas pressure by the addition or removal of weights. With ancillary equipment comprising a pressure measuring device, *e.g.*, King's gauge, and micrometer cock for adjusting the gas flow, a test rig resulted giving an accuracy comparing favourably with that which would be obtained using modern less bulky equipment.

Finally, from its earliest days, the gas industry had to contend with the control of gas pressure. Without booster plant, it was essential to use the pressure obtained from the weight of the gasholder to distribute the gas through the district. With holders of more than one lift, this pressure was naturally variable, asd severe pressure fluctuations could be put on the district when cupping and uncupping occurs. In addition, at times of load change on a district, arrangements had to be made to regulate the supply pressure so that the consumers' pressure could be maintained. As Walter Hole pointed out in his great book 'The Distribution of Gas', published in 1907, automatic control of pressure was imperative since it was impossible that the supply of gas to a district should be at the mercy of a man stationed at the works, opening and closing valves at a discretion.

The challenge of automatic control was met by the industry, and station governors developed in the last century—the Braddock, Cowan, Parkinson and other station governors are still in current use, having proved their essential reliability.



The new installation of

Continuous Vertical Retorts at the Smethwick Works

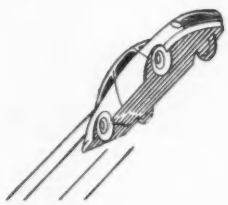
of the West Midlands Gas Board

WOODALL-DUCKHAM

CONSTRUCTION COMPANY LTD

Woodall-Duckham House, 63-77 Brompton Road, London, S.W.3. 'Phone: KENsington 6355 (10 lines) 'Grams: Retortical (Southkens) London

What's all this about 'AROMATICS'?



Q. To begin with, why the name 'Aromatic'? What has smell got to do with it?

A. *The name was applied originally in the 19th century to hydrocarbons of a certain type which, chemists discovered, were produced from sweet-smelling balsam and spices. It is now used to denote a particular family of hydrocarbons.*

Q. You said something about hydrocarbons. What are they?

A. *That's the chemist's name for thousands of substances—solid, liquid or gas—which consist of hydrogen and carbon in varying proportions. The crude oil from which motor-spirit is distilled consists of almost nothing but hydrocarbons—grouped by the chemists into 'families' such as naphthenes, paraffins, olefines and aromatics.*

Q. Very interesting to chemists, no doubt, but what on earth has it got to do with me?

A. *We thought you'd like to know just why the new National Benzole Mixture is so good!*

Q. Well, go on—why is it so good?

A. *Because these aromatics are largely responsible for all the qualities that these days are really needed in a modern motor-spirit—such as high anti-knock value, smooth running, better mileage and better starting*

Q. Why?

A. *That is one of the facts of life, like why grass is green.*

Q. Do all motor-spirits contain aromatics?

A. *Nearly all contain a little: and a great deal of time, ingenuity and money is being spent on trying to produce more of them.*

Q. How can you do that?

A. *In two ways. Firstly, you can build elaborate and costly units such as 'Catalytic Cracking Plants' and 'Platformers' to turn other less useful hydrocarbons into aromatics. This is primarily what all the latest refineries are built to do.*

Q. I'll take your word for that—what about the other way?

A. *You just take advantage of British produced Benzole (distilled from coal) that consists of* nothing but aromatics. *So you merely add Benzole to petrol, and that automatically does the trick.*

Q. You mean that National Benzole Mixture has *always* had a lot of aromatics in it?

A. *Certainly—that's why it's so famous for its smooth-running, its easy starting and its better mileage.*

On the principle that you can't have too much of a good thing, Benzole is now blended with a new petrol from a modern refinery, a petrol that is richer than ever before in aromatics— and the NEW National Benzole Mixture has more than double the aromatic content of any other motor-spirit.

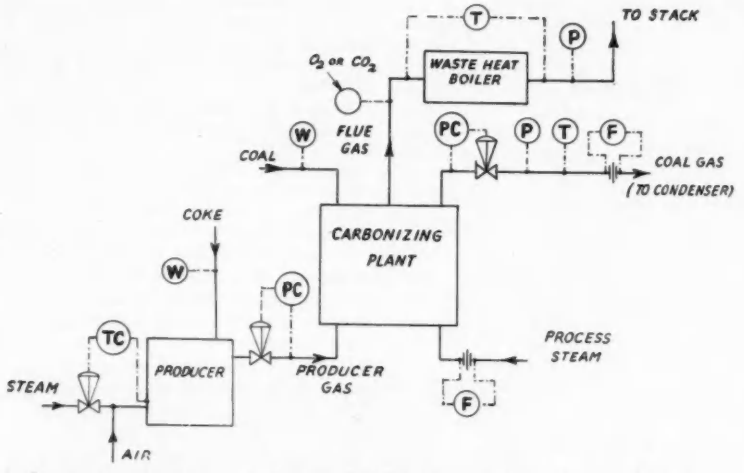
Q. Will I notice any difference in the performance of my car?

A. *Try a tankful—and see how the NEW National Benzole Mixture meets every requirement of the modern car. It is the most modern of motor-spirits and ahead of today's engine design!*

NATIONAL BENZOLE MIXTURE HIGH-AROMATIC

THE FIRST HIGH-AROMATIC FUEL

NB31/Q



P. Pressure measuring inst.
T. Temperature measuring inst.
F. Flow measuring inst.
L. Level measuring inst.
Tc. Automatic temperature controller.
Pc. Automatic pressure controller.
W. Weight measuring inst.
O_2. Oxygen % measuring inst.
CO_2. Carbon dioxide % measuring inst.

Fig. 1. Diagrammatic arrangement of retort house instrumentation.

INSTRUMENTATION FOR THE CARBONIZING PROCESS

The measurement of the weight of incoming coal has long been established as the basis of all accountancy in the retort house, and the conventional rail and road weighbridges have been employed for many years. For sea-borne coal, a modern development now widely used is the continuous weighbridge, employing a conveyor belt system.

Weight Measurement

Modern weighing machines of both the intermittent and continuous type have reached a high standard of excellence and will register weight with an accuracy of a fraction of 1%. However, in the instance of coal and coke weight measurement, this high degree of accuracy does not appear to be of particular significance, since errors in the net weight resulting from the presence of moisture will far outweigh any error inherent in the weighing machine. Thus, while the gross weight may be virtually exact, the net weight may be different from this on account of moisture by up to 20% or more. In addition, the discrepancy can vary rapidly with changes in atmospheric conditions. Here it may be pointed out that, from the point of view of plant efficiency, it is not the weight of the fuel which is important, but the useful energy it contains. Therefore, in the absence of means for the continuous measurement of energy supplied to the plant, any measurement of weight must be linked with adequate laboratory facilities for the analysis of fuel samples.

Since the net, *i.e.*, dry, weight of fuel is the important factor, it would appear that, where a conveyor belt system is used, a volumetric method of measurement may be adopted. Knowing the bulk density of the fuel, the volume measurement can readily be converted to weight units. In this connection, it is contended that the bulk density of any particular type of reasonably dry coking coal, *e.g.*, South Yorkshire, is constant to within about ± 2%, irrespective of the size of the individual particles or lumps and of the district or country in which it is mined.

The principle of operation of a volumetric 'weighing' machine of this type is illustrated in Fig. 2. As will be seen from the illustration, it is very simple, the instrument consisting of a hinged 'measuring door', the lower edge of which rests on the surface of the coal being carried forward on the belt. A conventional form of integrating unit multiplies the gate position by the speed of the belt, giving the result, in volume units, on a counter. Variations of this principle can, of course, be applied to a screw convenor or in instances where the coal is delivered through a chute.

In spite of the statements made in the foregoing, it must be pointed out that the subject of weight measurement inferentially by means of volume, versus direct weight measurement, is a controversial one. An accepted authority on all matters appertaining to fuel is 'Technical Data on Fuel', fifth edition, published by The British National Committee, World Power Conference. This states (pp. 406-407), that the bulk density of loosely packed coal is not reproducible to within 5% except under closely controlled conditions of measurement. Also, that compaction may increase the value by anything up to 20%. This reference book also gives tables of the bulk density of loosely packed dry coal, and these indicate that a variation is obtained not only with the grading of the coal but also with the size of the container used for the volume measurement. The majority of industrial weighing machines, whether intermittent or continuous in form as distinct from the volumetric type, utilize a gravimetric principle, involving knife-edges, levers and tie-rods.

Among the methods for obtaining a counter record of the weight continuously passing over a belt is to arrange for the steelyard to deflect in a manner proportional to the load and detect this at short intervals by gripping the steelyard. The magnitude of the deflection is sensed by mechanical means and used to actuate the counter. Electronic equipment is also used for this purpose, the position of the steelyard being detected by a photo-electric cell assembly. This system enables a continuous measurement to be obtained without imposing any load whatsoever on the weight sensitive element.

A system is also utilized whereby the weight is converted into a fluid pressure, the value of which can be measured and translated into terms of weight by what is, essentially, a pressure gauge. The basic idea is illustrated in Fig. 3. One end of the weighing span of the conveyor belt is supported by blocks, while the other is supported by a diaphragm which seals one end of a liquid filled system, the other end being sealed by a pressure gauge. The pressure resulting from the load imposed on the diaphragm by the weighing section of the conveyor, together with that from the weight of material on this section, is thereby transmitted to the gauge calibrated to register in weight units. To eliminate the weight of the weighing section and the effect of any variations in weight caused by any material adhering to the returning section of the belt, a compensating system, consisting of a second sealed liquid device, may be used. Each end of this system is sealed with a diaphragm and, as illustrated, one would support the free end of the upper weighing span, and the second the free end of the lower span. The effect of the compensator would be to increase or decrease the load on the measuring diaphragm by an amount proportional to any difference between the weights of the two sections of the weighing span. Only a small amount of power can be obtained from the pressure gauge type measuring element; therefore, for integration purposes and also to obtain a powerful movement for other purposes, *e.g.*, automatic control, a power amplifier would be incorporated. There

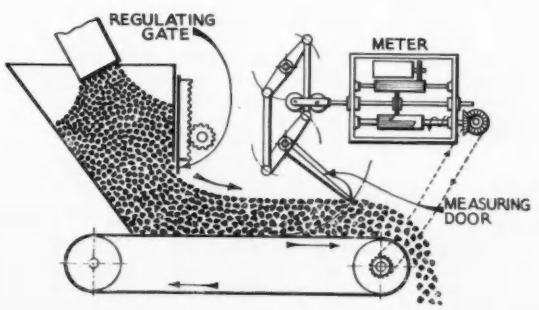


Fig. 2. Principle of operation of the Lea 'Cubimeter.'

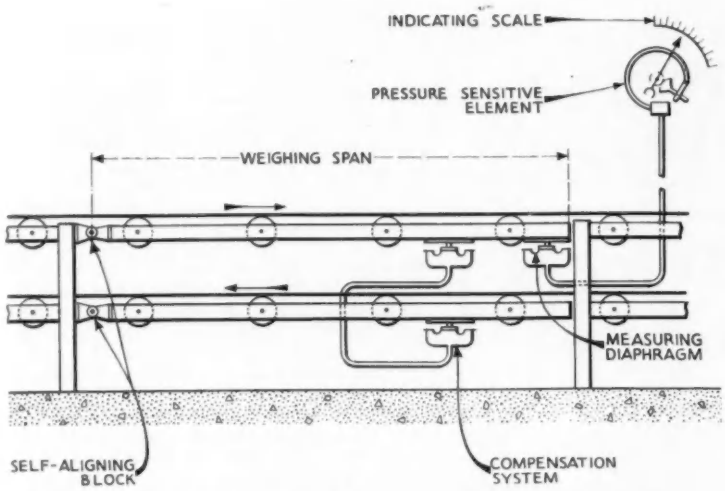


Fig. 3. Hydraulic system for registering weight of flow on a conveyor.

are a number of methods of obtaining the desired result, and it is convenient to consider them in conjunction with automatic control.

Automatic Control of Weighing Machines

From many points of view it is desirable to maintain a constant feed of coal for the efficient operation of blenders

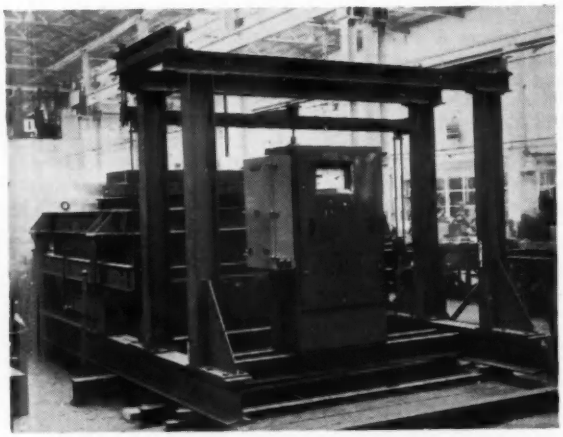


Fig. 4. The hopper weigher and totalizer for use in the unloading of coal from ship to shore by grab crane.

and coal crushers and breakers, and a number of systems have been developed for this purpose.

An elementary form of automatic control of a weighing machine is illustrated in diagrammatic form in Fig. 5. The desired weight per unit time is determined by the position of the counterbalance weight on the scale beam. If the weight of flow increases, the right-hand extremity of the scale beam is deflected downwards and the feed gate lifts, the reverse occurring on a decrease in load. This will be recognized as a proportional form of control action, coincidence between the desired value of the weight and the actual value only being obtained at one particular setting of the desired value. In addition, a considerable load is imposed on the measuring element, *i.e.*, the controller is of the self-actuated form.

In more advanced forms of automatic control of weighing machines of this description, the feed gate height is adjusted by a reversible electric motor. In one design of such equipment, a small deflection of the weight-indicating pointer energizes one or other of two electronic switches which applies a grid bias to a triode valve. The triode valve operates relays which cause the electric motor to rotate and move the gate in the required direction to reduce the deviation. A time operated interrupter switch stops the motor for a short period at regular intervals. If insufficient correction has been made, the motor receives another impulse and the process is continued. If an overcorrection has been made, the other electronic switch is energized and the rotation of the motor is reversed. This control action is of the multi-step form, and virtually no load is imposed on the measuring element since negligible power is required to operate the electronic switches; all the power is derived from an electrical supply.

The trend in the design of industrial automatic controllers is towards compact units which can be used in conjunction with a wide range of instruments measuring any physical variable, *e.g.*, temperature and flow and, of course, they can be used in conjunction with weighing machines. They all utilize an external source of power so that virtually no load is imposed on the measuring element. The source of power may be derived from an electricity supply, a liquid (oil or water) under pressure, or compressed air. Within recent years, industrial electronic control equipment of this particular form has also made its appearance. The function of the measuring instrument is to apply an input signal to the controlling unit, proportional to the measured variable—referred to as the 'controlled condition' in automatic control engineering. As indicated in the foregoing, an extremely weak signal is all that is required. The function of the controlling unit is to analyze this signal, compare it with a signal proportional to the desired value of the controlled condition, and give a powerful output for operating a suitable regulator which adjusts the value of the controlled condition to coincide with the desired value. Depending on the design of the controlling unit, the input signal may be a mechanical displacement, a force, *e.g.*, air pressure, or it may be electric. The output signal from the controlling unit is generally a fluid pressure or it may be electric in character. The important point is that the controlling unit is entirely 'unaware' of the nature of the controlled condition and is purely an 'analyzer' of signals fed to it. In addition, the controlling unit may be a separate entity which can be coupled to the measuring instrument in a manner determined by the characteristics of the two units.

Controlling units have been developed to give a number of forms of control actions. One of the simplest is a proportional action, in which the output from the controlling unit is proportional to the difference between the desired value of the controlled condition and the actual value. While suitable

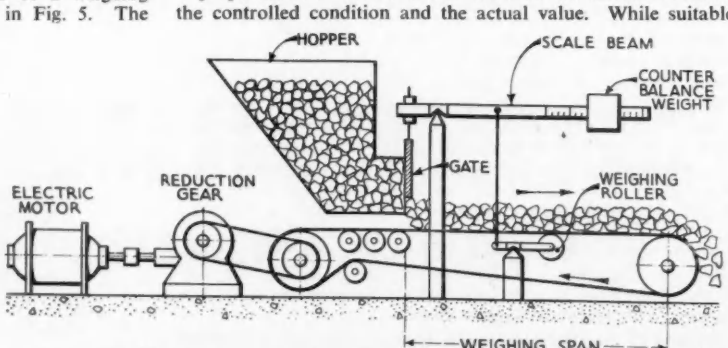


Fig. 5. Principle of operation of automatically-controlled continuous weighing machine.

for many applications, it suffers from 'offset', *i.e.*, a sustained deviation between the desired value and the actual value. As indicated when reference was made to an elementary form of self-actuated proportional controller for a weighing machine, a coincidence of the two values can only be attained at one particular plant load. The next is integral action where the output from the controlling unit changes at a rate proportional to the deviation. This ensures that the deviation is reduced to zero. Its disadvantage is that it is unstable and 'hunting' may result. Therefore, it is frequently combined with the proportional action to give what is known as a 'two-term control action'. Finally, there is the derivative action, in which the output from the controlling unit varies directly with the rate of change of deviation. This control action cannot be used alone as it is only sensitive to rate of change of the input and not the actual value of this. Therefore, it is used in conjunction with the proportional or proportional plus integral actions, in which latter case a three-term control action is obtained. The derivative action, in general, is only used in difficult control problems. At the present time, pneumatic controlling units seem to have the widest application throughout industry, the power for operation being derived from a compressed air supply.

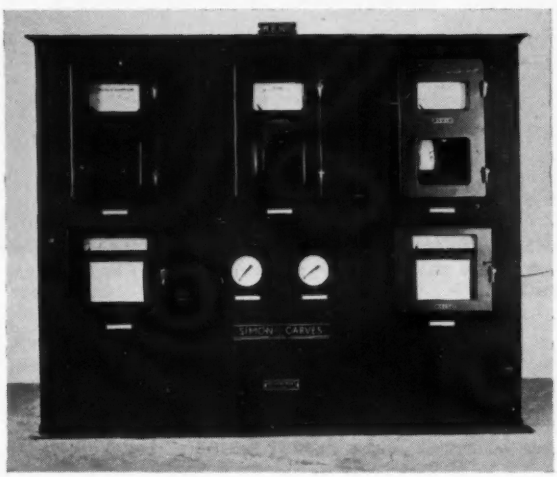


Fig. 6. Coke-oven instrument panel showing gas flows, pressures and temperatures, and also steam and liquor pressures

In one, position balance, class of pneumatic controlling units, the pointer of the measuring instrument positions a flapper with respect to a nozzle fed with compressed air. The consequent change in pressure within the nozzle system is fed back to the flapper via a bellows or similar unit and a differential link, in such a manner that the flapper is returned to substantially its original position but with a different air pressure within the system. This air pressure, via a relay to boost the volume, is applied to the regulator. The manner in which the controlled output air pressure changes is determined by the control action. For example, with integral control, the air pressure will continue to change, and consequently the regulator continues to move until such time as the value of the controlled condition coincides with the desired value. The only work to be done by the measuring instrument pointer is to deflect the flapper—and the overall movement of this is only of the order of 0.001 in., while the diameter of the nozzle is of the same order, with a maximum air pressure of 15 lb. per sq. in. In an alternative arrangement, the flapper is moved in a plane at right angles between two opposing nozzles fed from a common air supply.

A position balance controller, having any desired combination of control actions, can be applied to the 'pressure' type weighing system described earlier in this article. The pointer of the pressure measuring element would actuate the flapper, and the controlled output air pressure would be applied to a servo motor, *e.g.*, a spring loaded diaphragm or a piston located within a cylinder, the displacement of which would adjust a feed gate or other device used for altering the rate of feed to the belt. A controlling unit of this description could maintain a constant weight of flow under the most arduous industrial conditions. A controlling unit, having a proportional only control action, can be used as a transmitter.

Measurement and Automatic Control of Gas Pressure

The measurement of the pressure of gas being evolved from carbonization systems has an important bearing on the efficiency of gas production. The velocity with which the gas can pass through the incandescent section of a charge will determine the therms which will be available for every ton of coal carbonized. The incandescent barrier of carbon causes reaction to take place with hydrocarbon gases, both saturated and unsaturated, to reduce their calorific value by breaking them down to hydrogen and carbon monoxide.

Instruments for measuring collecting main gas pressures have developed from the original U-tube form of manometer, and particular reference may be made to the inclined-tube manometer, by which means a considerable linear displacement of the liquid level in a glass tube can be obtained for a small change in pressure. Another type of instrument for accurately measuring small pressures is that employing a spring loaded bell, having a large cross-sectional area, suspended in a bath of oil or other liquid. By using suspension springs of appropriate 'rate', a substantial bell displacement can be obtained for small pressure changes. Advances in the manufacture of diaphragms from various synthetic materials have resulted in the recent development of sensitive 'dry' type pressure measuring systems in which the diaphragm acts as a seal and the 'rate' of loading spring determines the pressure/deflection characteristic.

The automatic control of these pressures has always been considered as essential, and manual regulation has never been contemplated, even on the smallest and most crude plants. It is not proposed to discuss the older types of retort house governor, but three modern systems are worthy of some consideration; these are, the relay governor, the hydraulic governor and the pneumatic governor.

The relay governor, illustrated in diagrammatic form in Fig. 7, employs a supply of town's gas under a pressure equivalent to a few in. W.G. as the servo fluid. Referring to Fig. 7, the gas pressure—actually vacuum—to be controlled is applied to one side of a spring loaded diaphragm actuating a bleed valve, through which the town's gas is discharged into the foul gas main. The town's gas supply is throttled by a manually adjusted needle valve, so that the gas pressure output from the controlling unit to the regulating unit is determined by the opening of the bleed valve. If the foul gas pressure tends to increase, the diaphragm is displaced upwards, the bleed valve moves towards the closed position, and the output gas pressure rises. Conversely, the output

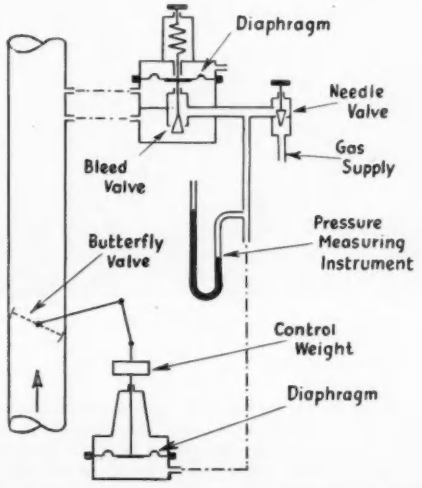


Fig. 7. Diagram of relay governor for automatic pressure control.

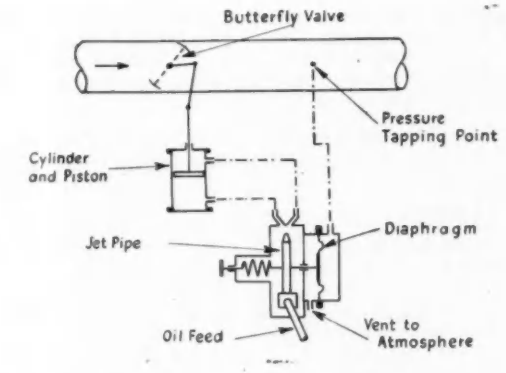


Fig. 8. Diagram of hydraulically-operated governor for automatic pressure control.

gas pressure falls if the foul gas pressure decreases below the desired value. The regulating unit consists of a diaphragm motor which, under the influence of the pressure applied to it, moves a damper or butterfly valve, located in the foul gas main, in the appropriate direction to return the foul gas pressure to the desired value. The desired value of the pressure is set by an adjustment of the measuring diaphragm loading spring. To prevent fouling of the measuring diaphragm, contact between the foul gas and the diaphragm is prevented by continuously bleeding a small amount of clean town's gas into the chamber on the underside of the diaphragm. This governor has the merit of employing a source of operating power which is readily available and excludes foul gas from contact with its working parts.

The hydraulically operated governor, illustrated in Fig. 8, employs oil under pressure as the servo fluid. Referring to Fig. 8, oil is fed to a pivoted jet pipe, the outlet from which is located opposite to two orifices which are connected, respectively, to the opposite ends of a cylinder containing a piston—this latter assembly forms the regulating unit. The jet pipe

Fig. 9. Hydraulically-operated governor for coke-oven collecting mains.

is linked to a diaphragm which is spring loaded on one side and subject to the gas pressure to be controlled on the other. Under conditions of equilibrium, when the gas pressure coincides with the desired value, the jet pipe is in its central position, mid-way between the two orifices, and the jet pressure is evenly distributed between the orifices. Consequently, there are equal pressures on each side of the regulator piston. When the gas pressure changes, the deflection of the diaphragm displaces the jet pipe away from one orifice towards the other, causing a build up in pressure on the side of the piston in communication with the latter orifice and a decrease in pressure on the other side. The resulting displacement of the piston moves the butterfly, or other type of valve, in the gas main in the appropriate direction to reduce the deviation. This action continues until the deviation is reduced to zero, *i.e.*, until the gas pressure is returned to its desired value, the jet pipe being brought back to its central position. The control action is of the 'floating' form, since no offset results from a change in load. The desired value of the pressure is set by a manual adjustment of the diaphragm loading spring. Attention is drawn to the fact that Fig. 8 does not show the oil circulating system.

With reference to pneumatic pressure controllers, in the foregoing it has been pointed out that the controlling unit may be a separate entity which can be used with any measuring device which gives a suitable output for initiating the control signal. In the case of pressure control, a pneumatic controlling unit could be applied to a conventional form of pressure measuring instrument. This instrument would be fitted with a manually set pointer indicating the desired value of the pressure, and any deviation from this pressure, as indicated by the measuring pointer would, via a differential link, displace the flapper or vane of an air fed nozzle system. One of the advantages claimed for the pneumatic system of control is the ease with which various control actions can be incorporated to meet requirements, so that, for example, virtually constant pressure can be maintained although conditions may be fluctuating widely.

Force Balance Controller

As distinct from position balance pneumatic controlling units mentioned above, force balance types are also available. In these the desired value, as well as the controlled condition, is expressed as a pressure. In the standard design of controlling units falling within this class, the range of input pressure is from 3 to 15 lb. per sq. in., *i.e.*, the same as the output pressure. Therefore, some means are required for converting the

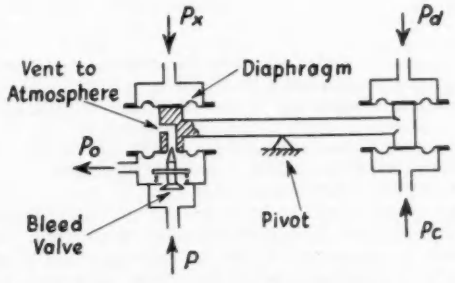


Fig. 10. Diagram of pneumatic force balance, automatic controlling unit having a proportional-only action.

measured variable into an air pressure of this magnitude. For example, if it is necessary to maintain a constant gas pressure at any value within, say, a band of 3 to 6 in. W.G., a convenient range, *e.g.*, 0 to 10 in. W.G., would be selected and means provided whereby 0 in. W.G. results in an air pressure of 3 lb. per sq. in. being applied to the controlling unit, and 10 in. W.G., a pressure of 15 lb. per sq. in. The means in question would be a pneumatic transmitter which, basically, operates in the same manner as a controller having a proportional only action as already described.

The operation of a proportional only pneumatic force balance controlling unit can be followed by reference to Fig. 10. The unit consists of two pairs of diaphragms mounted on a pivoted lever, the post connecting the left-hand pair of diaphragms forming part of a spring loaded bleed valve assembly, with vent to atmosphere. The desired valve pressure, *Pd*—set manually and maintained constant, is applied to the top right-hand diaphragm, while the air pressure, *Pc*, representing the value of the controlled condition, is fed to the lower right-hand diaphragm. A constant pressure, *Px*, is

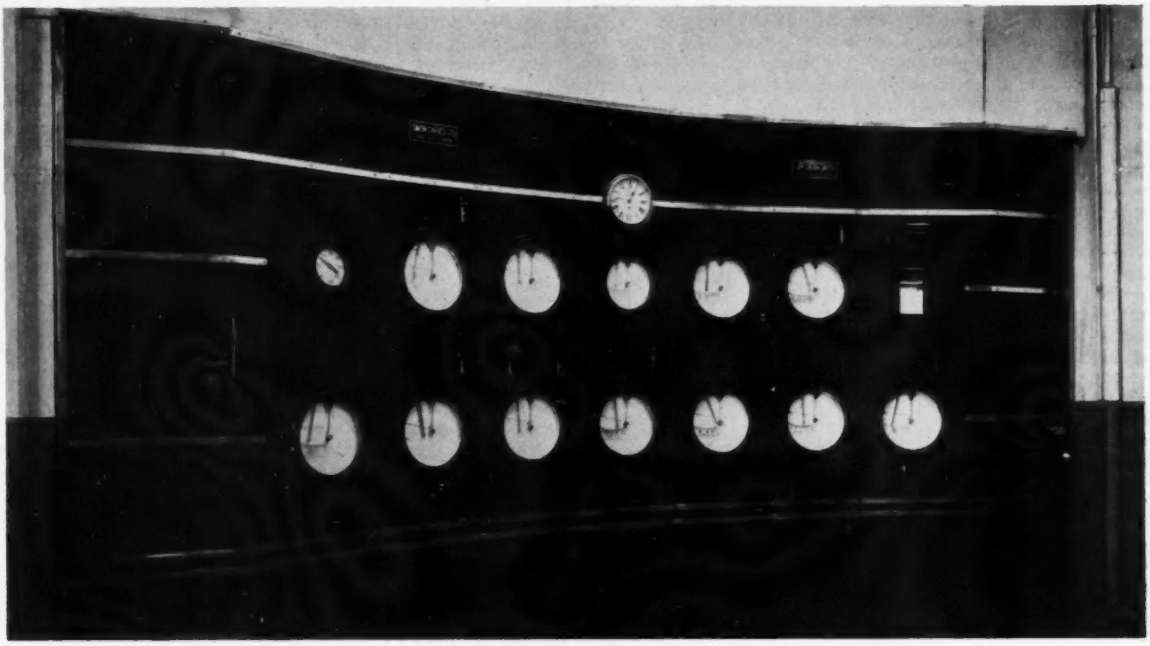


Fig. 11. A typical coke-oven instrument panel.

applied to the top left-hand diaphragm while pressure, *Po*, represents the controlled output air pressure. As indicated, the controlling unit is fed with air at pressure, *P*, which exceeds the maximum working value of pressure, *Po*. To simplify the description of the operation, it will be assumed that the lever is pivoted at its mid-point—in practice the position of the pivoting point would be adjustable.

When there is no deviation, *i.e.*, the value of the controlled condition coincides with the desired value, *Pc* = *Pd* and, for equilibrium, *Po* must equal *Px*. If a positive deviation occurs, *Pc* will increase, causing the diaphragm assembly to deflect in an anti-clockwise direction, the vent to atmosphere on the bleed valve will be closed and the inlet port opened, so that pressure *Po* will build up until a state of equilibrium is again reached where *Pd* − *Pc* = *Px* − *Po*, *i.e.*, the output pressure *Po* is directly proportional to the deviation. The pressure *Px* is sometimes applied by means of a spring. The ratio between change in *Po* with change in *Pc*, *i.e.*, the proportional band, is determined by the position of the lever pivoting point. In the mid-position, as assumed in the foregoing, the change in *Po* is equal to the change in *Pc* and a 100% proportional band is obtained. As the pivoting point is moved to the left, a greater change in *Po* with respect to change in *Pc* results—a proportional band less than 100%. Conversely, if the pivoting point is moved to the right of its mid-position, a proportional band greater than 100% is obtained. It will, of course, be appreciated that the deflection of the diaphragms is very small indeed. By modifying the design and using diaphragms of the appropriate size, a small change in pressure *Pc* can cause pressure *Po* to change over its full range of 3 to 15 lb. per sq. in., and the arrangement functions as a pneumatic transmitter to which reference has been made already.

In an alternative design, instead of a bleed valve, a nozzle and throttle plate device is used, the output pressure *Po* being fed back to the diaphragm which counterbalances pressure *Px*.

To obtain an integral as well as proportional action, pressure *Po* is applied to the upper right left-hand diaphragm, via an adjustable resistance and capacity, as shown in Fig. 12. A deviation, *i.e.*, difference between Pc and *Pd*, results in a change in the value of controlled output pressure *Po*, which is applied to the regulator. The regulator moves in the direction to reduce the deviation and at the same time the pressure on the top left-hand diaphragm is changing under the influence of pressure *Po*. Pressure *Po* will go on changing—and the position of the regulator also—until *Pc* again equals *Pd*, and there are equal pressures on the two left-hand diaphragms. The speed of action of the integral control action, measured in units of time, is determined by the setting of the resistance in the pressure transmitting pipe connecting the two left-hand diaphragms. Another diaphragm assembly is required to obtain the additional derivative action.

A trend in the design of force balance controlling units is to arrange for the diaphragms to be in a stack formation, but the principle of operation remains unaltered. The regulating means may consist of a diaphragm motor or cylinder with piston.

Measurement of Raw Gas Flow

The present necessity for attaining the utmost efficiency from carbonizing units renders it desirable to measure the gas output from each separate bed of retorts or sections of a coke oven battery. By this means, an overall performance check can be maintained. Unfortunately, the conditions of temperature and pressure of the gas at this stage of its manufacture

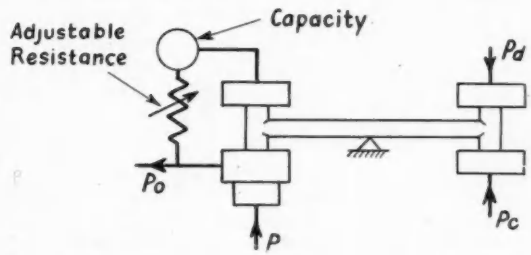


Fig. 12. Diagram of a pneumatic force-balance controlling unit having a proportional plus integral action.

makes it difficult to attain a high degree of accuracy in the measurement of the volume.

The accepted means of metering large quantities of any fluid is with the differential pressure form of meter. A restriction, in the form of an orifice plate, or other differential pressure producing device, is inserted into the pipe, and the pressure drop across this is measured and registered in terms of quantity of flow. A characteristic of all differential pressure meters is that they will only register the correct volume or weight of flow at some specified density of the metered fluid. Therefore, the reading is influenced by the specific gravity of the fluid, its temperature and, in the case of gases, by its pressure

and wetness as well. On the other hand, due to the square root flow law, the percentage error in reading is approximately half the percentage change in density. For example, if the density of the fluid changes by 5% from its mean condition, for which the meter is calibrated to read correctly, the percentage error in reading is approximately 2½%. Means for automatic correction for temperature and pressure variations have been evolved, and automatic correction for changes in specific gravity is also technically possible but, for general industrial use, the additional complexity and expense has not been found to be warranted.

It is generally assumed that coal gas, during its manufacture, is always fully saturated, particularly at the point where it leaves the foul main and its associated liquor sprays. If this assumption were correct, any form of metering at the temperature obtained, utilizing standard metering equipment, would not be possible—a temperature change of only 170°F. to 175°F. would cause the vapour pressure to alter by nearly 1½ in. of mercury. However, experience has shown that, at this point, the gas is far from saturated. With regard to specific gravity, tar fog causes slight changes in specific gravity which are not serious enough to cause metering errors of any real significance.

A difficulty experienced when metering raw gas is that resulting from the accumulation of pitch, ammonium chloride and other deposits on the upstream side of the orifice plate. A solution to this problem, which has proved satisfactory in practice, is to use a sector ('D' shaped) type of orifice plate instead of a conventional one with a central hole. The orifice plate is fitted with its chord vertical, so that only one side of the pipe is obstructed, and there is a free passage past the plate for condensed liquids. In addition, steam pipes are permanently teed into the impulse pipe connecting the registering instrument to the tapping points on the upstream and downstream sides of the orifice plate. Steaming periods of approximately two minutes every 24 hours have been found sufficient to maintain the orifice plate in a clean condition and the impulse pipes free from obstruction. A steam pressure not less than 5 lb. per sq. in. must be used to obtain sufficient heat and impulse effect for cleansing. Of course, during the steaming period it is of vital importance to make sure that the registering instrument is isolated. By adopting raw gas flow measurement, individual carbonizing unit rates and economic working life can be determined.

Steaming of Charges

The rate of steam admission to retorts of both continuous and intermittent types is of unquestioned importance, both for the control of calorific value and the overall economic operation of the retort house. For steam flow measurement, the orifice plate form of differential pressure flow meter is universally adopted, and on occasions a simple mercury-filled glass tube manometer has been used as the registering instrument. This practice is deprecated since, even though the steam is only at a pressure of a few lb. per sq. in., a fracture of the glass tube may result in a serious accident. The registering instrument should be of the float-operated mercury 'U' tube form or, alternatively, a 'dry' type bellows-operated instrument. Both these forms of instrument are available in various combinations for indicating, recording and integrating.

In the majority of instances, a reading of the total steam consumed is all that is required, and in such circumstances an integrating only rotary shunt meter may be employed. The instrument, which is bolted into the steam main, contains an orifice plate and a small turbine. The resistance of the orifice plate causes a predetermined percentage of the steam passing through the meter to flow round the orifice through a by-pass. In so doing, the steam impinges on the turbine which rotates at a speed directly proportional to total steam flow through the meter. The revolutions of the turbine, in terms of weight of steam, are registered on a counter. The speed of the turbine is maintained at a low value by damping vanes mounted on the turbine spindle which rotate in a chamber kept charged with water by steam condensation. The capacity of the meter is determined by the bore of the orifice plate. The rotary shunt meter has the same square root characteristic as a differential pressure meter, so the percentage error in reading occasioned by changes in density of the metered steam is approximately equal to half the percentage change in density. Rotary shunt meters are made in sizes up to 4 in. in diameter, and therefore cover the requirements for this particular application.

In some cases, with continuous vertical retorts, it has been necessary to provide automatic control of rate of steam admission. For this purpose, a standard form of pneumatic controlling unit may be used, actuating a diaphragm operated regulating valve located in the steam pipe.

(We acknowledge the courtesy of *Coke and Gas* in making available the blocks for Figs. 2, 3 and 5.)

(*To be continued.*)

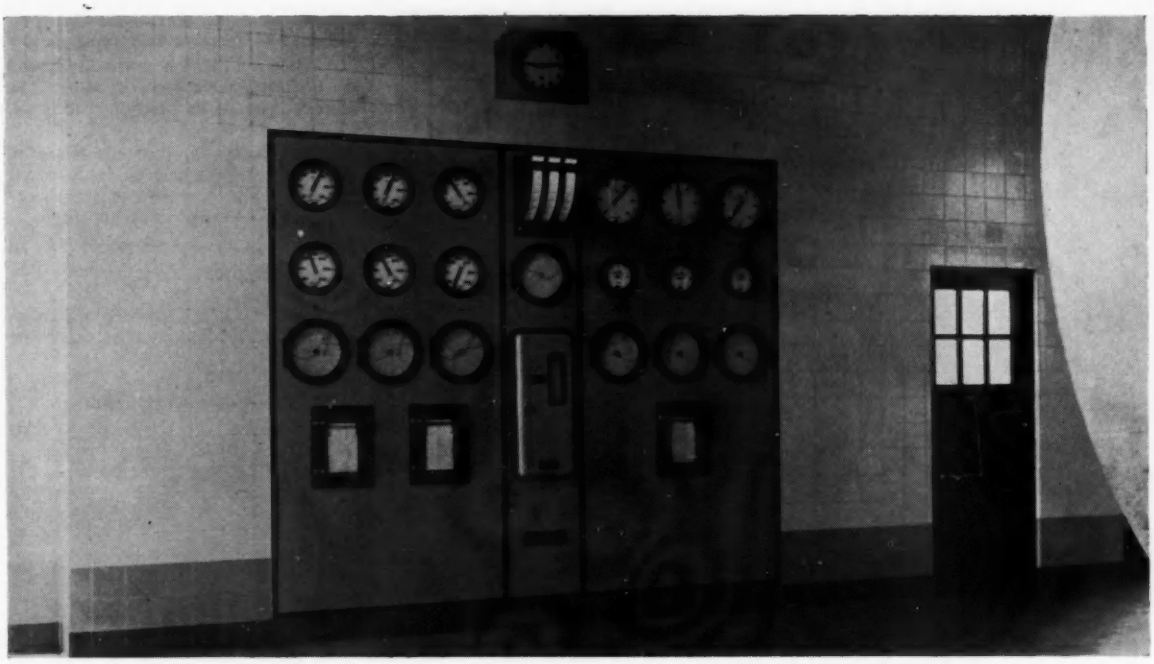
INSTITUTE OF CERAMICS

The achievements of the three major branches of ceramics —pottery, refractories, and heavy clay—the extending of their horizons, and the high level of skill and knowledge on which they depend, have been accorded formal recognition by the incorporation of Institute of Ceramics, Ltd., which can give expression to the corporate views of its member ceramists, and offers to all engaged in ceramics a professional qualification of repute and authority. The suggestion that such an Institute would be desirable had been made before the war, but at that time no steps were taken towards its realization. More recently the British Ceramic Society decided to take the lead in sounding the opinion of such organizations as might be interested in and support a professional Institute for ceramists. An exploratory meeting was held, and the verdict was unanimously in favour of setting up a representative committee to examine the possibility of forming such an Institute. The British Ceramic Society appointed representatives to serve on the committee with representatives from the British Pottery Manufacturers' Federation, National Federation of Clay Industries, Institute of Clay Technology, Refractories Association of Great Britain, and the Institute of Clayworkers.

The committee drew up a Memorandum and Articles of Association and By-laws and on June 16 the following officers were elected: President, Dr. A. T. Green, O.B.E.; Hon. Treasurer, Mr. L. Bullin; Vice-Presidents, Dr. W. L. German, Professor A. L. Roberts and Mr. G. N. Hodson, M.B.E.; Secretary, Mr. G. H. Stewart. The following were elected Honorary Fellows of the Institute, in recognition of their outstanding contributions to the several industries they have served for many years: Mr. H. Halliday, O.B.E., Colonel H. Johnson, D.S.O., Mr. H. J. Plant, J.P., Mr. E. Simpson, Lieut.-Colonel C. W. Thomas, C.B.E., and Mr. F. West, M.INST.GAS E. Membership, which is open to 'citizens of the United Kingdom by birth, by descent, or by naturalisation,' is divided into three main classes: *Licentiates* (L.I.CERAM), *Associates* (A.I. CERAM), and *Fellows* (F.I.CERAM). Applications can be considered from those who wish to be admitted to one of the three grades of membership, on the basis of qualifications laid down in the by-laws, copies of which can be obtained from the Secretary, Institute of Ceramics, Ltd., Federation House, Stoke-on-Trent, Staffs.

SULZER REVIEW

The latest issue of *Sulzer Technical Review* is devoted to the contribution made by Sulzer Brothers to the design of high-pressure pipelines for hydraulic power plant. The single main article deals in some detail with technical developments up to the present day and closes with accounts of a few noteworthy Sulzer pipelines. The first high-pressure pipe to be built by the firm was completed more than 75 years ago, in 1877. Since then, great changes have taken place, and the growing heads and rates of flow utilized in hydro-electric power stations have forced penstock designers to keep pace with them. One of the outstanding features of the progress made has been the general adoption of welding. The electric-arc welding of thick-walled, highly stressed and sometimes complicated pipes requires wide experience, and Sulzer Brothers also attach importance to the careful machining, heat treatment and testing of the welds. They were among the first to employ alloy steel plate for pipelines and to tackle the problems of welding and heat treatment thus raised.



Waste-heat boiler panel at Litchurch gas works, Derby, (East Midlands Gas Board).

Centralized Instrument Panels

By L. James, Assoc.Inst.GasE., M.Inst.F.

(Electroflo Meters Co., Ltd.)

THE modern tendency to centralize measurements of process variables is a significant development in the art of plant instrumentation. The early 'technique' of instrumentation merely involved the siting of small dial indicators, water gauges and sometimes recorders adjacent to the point of measurement. There is, of course, much to be said for locating reading instruments near points of manual control on the plant. The effect of any adjustment on the quantities concerned are immediately observed and further adjustment made if necessary. The installation of instruments dispersed about the plant should be planned carefully and with future maintenance in mind. It often occurs that recording instruments, especially, are situated in inaccessible or dark places, to the detriment of their future use and care. Consequently they soon become faulty for lack of periodic attention, or fall into disuse.

It is not the purpose of this article to compare the advantages and disadvantages of dispersing instruments or of grouping them centrally, but to focus attention on the centralized panel technique when this course has been decided. Control panels grouping a comprehensive array of measurements together with auxiliary controls and alarms are comparatively recent items of gasworks equipment. They are worthy of a place among those developments in the gas industry which have come about through the constant search for greater efficiency.

Direct Measurement Transmission

A fundamental aspect of centralization is the transfer of the various measurements from primary tapping points on the plant to the reading instruments on the control panel. There are three methods available:—

(1) By direct impulse pipes to mechanically-operated receiving instruments.

(2) By electrical transmission.

(3) By pneumatic transmitters via air lines to mechanically-operated receiving instruments.

Of these, direct piping of the medium under measurement is the most straightforward and least costly, yet fraught with the most difficulties so far as installation and subsequent maintenance are concerned. Pipe runs must be kept as short as possible and properly sloped for the drainage of unwanted liquids. Piping material must be in all respects suited to the application.

When transferring foul gas pressure to a remotely-mounted, mechanically-operated indicator or recorder, the impulse line should be generous in size (say $\frac{1}{2}$ in. to $\frac{3}{4}$ in. internal diameter if the run is over 50 ft.). Crosses and tees should be installed, when changing direction of the impulse line, to facilitate rodding through in case of chokage. Self-draining seals or siphon pots are sometimes installed to advantage. Cokefilled filters or clean-gas purge methods of preventing tar fog entering pressure or vacuum gauges are now usual accessories to a trouble-free installation. A full discussion on this is beyond the scope of the present article, but suffice it to say that very great care is required in the installation of remotely-mounted instruments which derive their operating forces through direct pipe connections.

Measurement Transmitting by Electrical Methods

Measurements can be transferred electrically by a measuring and transmitting element connected to the plant at the point of measurement. The impulse pipe connection to an electrical transmitter can and should be kept short, but the distance between this and the reading instrument(s) may be almost unlimited. In flow measurement the primary measuring device will be an orifice plate or other differential producing medium. For temperature measurement thermocouples or resistance bulbs will produce the electromotive force or condition required to operate remotely-installed indicators or recorders. It was the advent of the electrically-operated gas flow meter brought to this country from America in 1923 which gave the gas engineer a wider choice of location for the reading instruments or panels. Fig. 1 shows one of the first such installations in this country, at the plant of the Harrington coke works.

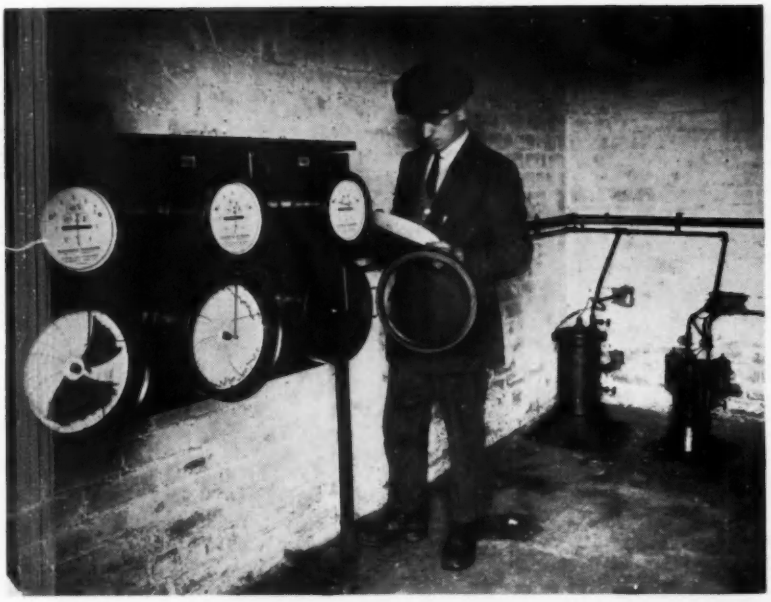


Fig. 1. Some of the first electrically-operated flow meters installed in a British coking plant.

Electrical methods of transmission (and there are several) have certain inherent advantages which account for their wide use in all industries. The most delicate primary element response can be transmitted with a minimum of distortion or friction effects. Time lags in transmission are negligible and the transmission lines are relatively cheap and easy to install.

The most commonly employed electrical transmitting device varies current in the meter circuit proportionally to the measured variable. The receiving indicators, recorders and integrators are basically current measuring instruments of more or less orthodox design. The main advantage of this method of electrical telemetering is the flexibility possible in the provision and location of various reading instruments around the plant. For example, a large dial indicator may be so placed as to suit, visually, a plant operator required to carry out adjustments nearby; the recorder associated with this same measurement may be situated elsewhere in an office, where charts are removed and studied; integrators may also be mounted there or perhaps at a further point where the summation of a number of process products are carried out. Again, this subject is too wide to discuss at length, but it fits very much into the complete picture of centralization.

Pneumatic Transmission

Pneumatic methods of measurement transfer are especially desirable where the use of electricity would constitute a danger due to the existence of, or possibility of, an explosive atmosphere, or where electric power is not readily available. Pneumatic transmitters adjust a 15 lb. per sq. in. air supply in accordance with the flow, pressure or temperature, etc., being measured. This proportional pressure is conveyed through $\frac{3}{32}$ in. internal diameter copper tubing to the remote reading instruments which are pressure gauges of conventional design calibrated in appropriate units of the measurement concerned. No great lag in response occurs, as a full-scale change in pressure requires only 20 seconds in 200 ft. of transmission line, or 0.7 seconds for 1% change in pressure.

Centralized Grouping

By one method or another, as briefly described, the various measurements are transferred from tapping points on the plant to the place selected for the instrument panel. Reasons for grouping a number of related measurements together on a panel can be summarized as follows:—

(1) It is often where the action or operation of the plant can be more readily appreciated by the simultaneous observation and consideration of the various significant quantities.

(2) To save the time of skilled personel and to increase their efficiency.

(3) When the plant concerned is spread over a considerable area, to reduce the walking distances in checking recorded data.

(4) To locate the instruments in a clean atmosphere when the plant itself is dirty or where corrosive or excessively hot atmospheric conditions prevail.

(5) To facilitate the servicing of numerous recorders (chart-changing and ink renewal).

(6) As a means of reducing the number of operators required to run the process.

Modern Centralizing Schemes

When most of the large gasworks built in recent years were being planned, a combination of several of the foregoing conditions influenced the decision to panel-mount and centralize much of the instrumentation. Among the many good examples of centralized instrumentation are installations at Bath, Birmingham, Bristol, Derby (title block), Dumbarton, Liverpool, Manchester, Northampton, Pontypool, Smethwick, Stockton, Tingley, Tottenham and Walsall.

Most instrumentation in gasworks is installed in retort houses, but there is a growing tendency to provide panels on other than carbonizing plant. In planning the layout of a new works some consideration is usually given to the 'points of control.' Obviously, these will be parts of the plant requiring the constant services of an attendant. The exhauster house

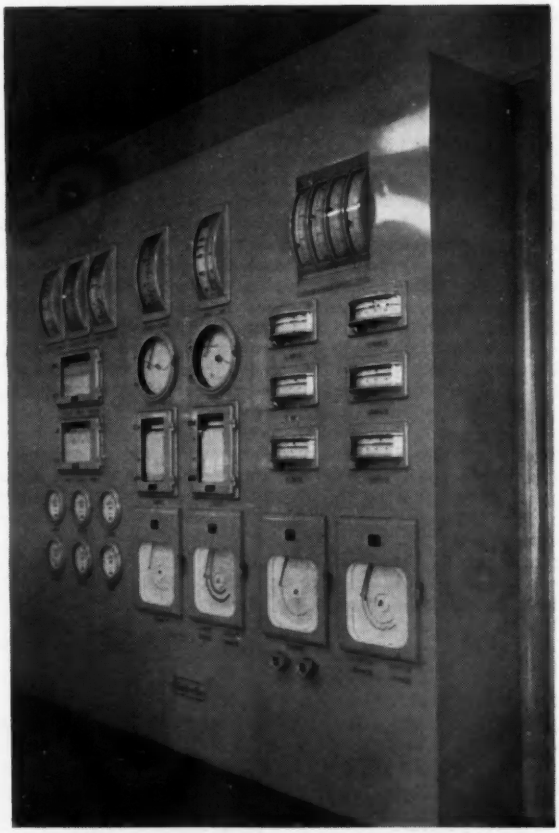
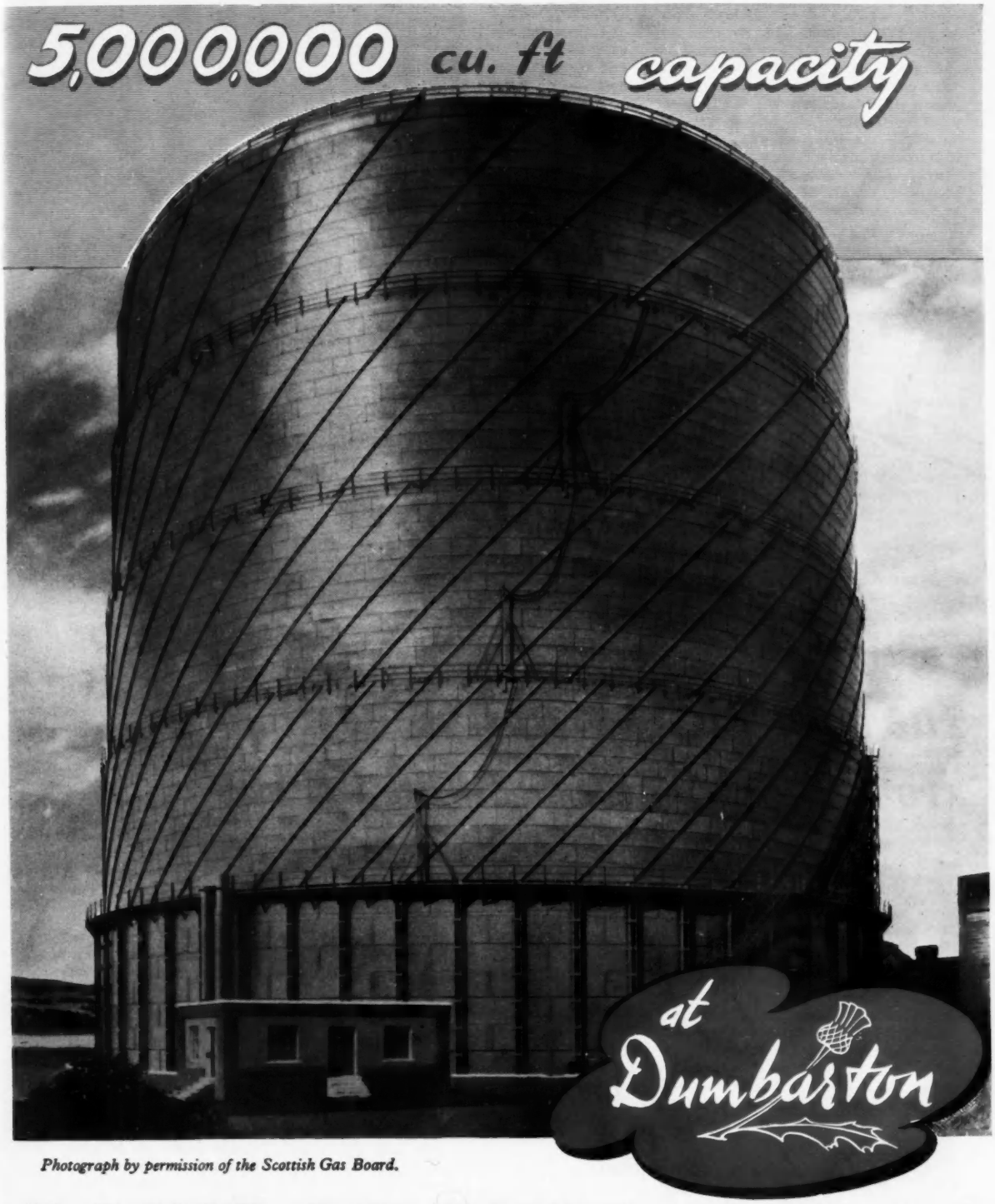


Fig. 2. Works control panel at Swan Village gasworks. (West Midlands Gas Board.)



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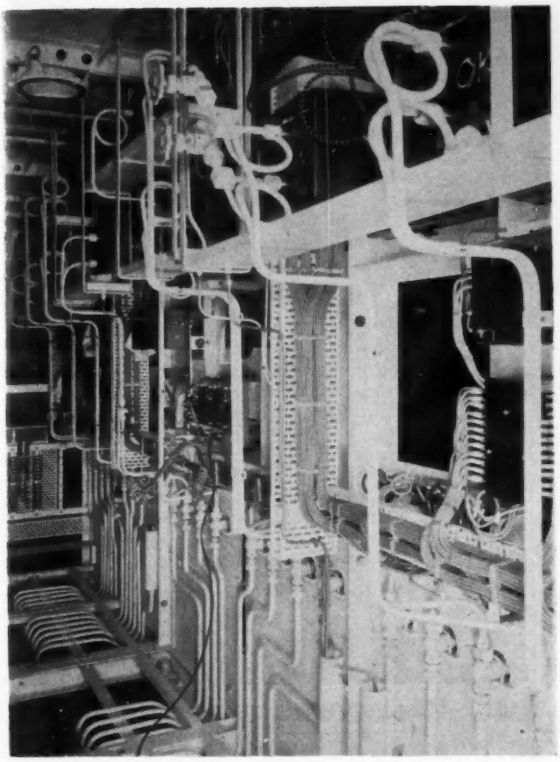


Fig. 3. Interior of a typical cubicle panel; layout is designed for accessibility.

and retort house are two such points and a third might be the booster or governor house. By-product plant and power houses are, of course, separate considerations. Panels installed at these points enable operators to control the process accurately. It has been said, on the subject of shift supervision, that the centralization of indicating instruments results in the plant itself receiving scant attention; the operator probably neglecting the routine adjustment of valves well away from his normal station, in favour of an occasional glance at the dials. The answer to this is to operate control valves from a distance. A definite psychological reaction accrues as the operator's imagination is captured by his ability to control closely the 'instrument reading.' He may become so interested in the instrument that the very closest control is maintained.

Retort House Panels

Instrumentation in the retort house is conveniently classified in accordance with the main items of plant housed therein, viz.:

(1) The carbonizing benches themselves (including retort house governors).
(2) Waste heat boilers.
(3) Producers (mechanical or built-in).
(4) Liquor system.

Where all the instruments are centralized on a single panel, sections are often divided by distinctly coloured strips, separating the instruments appertaining to each part of the bench. It is more usual, and often desirable, to install separate panels in various parts of the retort house. This avoids long runs of piping to any instruments directly operated. Thus panels covering governor and collecting main measurements, are installed at top of setting level, while producer and retort steam meters are mounted on a panel at ground level.

Panels or cubicles should be sited where there is plenty of access both at front and rear and on a foundation free from vibration. Lack of space may suggest the fitting of the panel into a wall with rear access through an annexe to the main building, if necessary. At Northampton the 'carbonizing panels' are in the pump room adjacent to the retort house.

It is altogether unreasonable to expect laboratory working conditions in a retort house where so many conditions detrimental to instrument operation prevail as a natural consequence of the process. But the value of an instrument lies in its utility which, in turn, depends on the continued maintenance of its intrinsic accuracy. One good solution to the problem of keeping instruments free from dust, dirt and changing temperature conditions is to surround the panel by a glazed cabinet. Good examples may be seen at the new Stapleton Road works, Bristol, Swan Village works, Birmingham, and at Tingley works (near Leeds). A brick-built room houses the waste-heat boiler panels at Athol Street works, Liverpool, and this is pressurized by a blower, drawing in filtered air from the outside. A 'top of setting' panel at St. Helens is of virtually air-tight construction and is automatically pressurized when the panel door is opened. When instrument rooms are pressurized to discourage ingress of dust, the zeros of low-range pressure indicators or recorders should be adjusted with the fans running.

Condensers, Exhausters, Washing and Purifying Plant

Complete instrumentation on the works includes panels covering the essential measurements for the technical or chemical control of the many separated plant units concerned. Condenser panels may include alarms for high outlet gas temperature and low flow of cooling water. Exhauster house panels are almost universal on new works and often include certain condenser measurements and a set of dials or water column gauges to show the progressive drop in gas pressures from outlet exhauster to inlet purifiers. The clean-gas purging in gauge lines before the exhauster cannot, of course, be applied on the pressure side. The practice then is to use air from blowers; usually a bleed from the revivification air to purifiers. The exhauster house is usually regarded as a good centre of control and panels installed here may include key measurements and alarms covering the whole works.

An increasing number of new gasworks install power generation plants with boiler and turbine panels alongside the electrical power boards and switchgear. Among recent installations the power house panel at Swan Village is seen in Fig. 2. The instruments on the panel indicate and record the key measurements of gas, steam and water on the works. The most vital of these are displayed on 17 in. long 'giant scale' indicators.

Design of Panels and Cubicles

The first phase in the manufacture of a panel is the evolution of a front face layout for instrument display. The gas undertaking, plant contractor and panel manufacturer collaborate and finally agree on this. The result, in the form of a 'project drawing' becomes the basis of a contract and the beginning of a skilfully evolved process of manufacture. Of the various materials which have been used for panels and cubicles, steel is still generally favoured. For front faces, aluminium, plastic, ebonite and sindanyo board are employed when particularly requested by the user.

Panel faces and desks are usually constructed of $\frac{3}{16}$ in. or $\frac{1}{4}$ in. thick hydraulically-flattened mild-steel sheet. For side covers, canopies, etc., a lighter gauge, usually $\frac{1}{8}$ in. or $\frac{1}{16}$ in. is employed. Angle and channel sections from $\frac{3}{4}$ in. by $\frac{3}{4}$ in. by $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. are used for main frameworks; lighter angle and flat sections for internal brackets and straps, etc. Cost and weight are related, and design still keeps both within bounds.

Rounded-corner construction is sometimes preferred for appearance and light-gauge material is rolled up to 1 in. radius. The need for angle iron framework is then eliminated or reduced, but this construction is usually limited to the smaller cubicles; although by the use of steel tubing and welding technique or by unit construction, quite large cubicles can be treated in this way with very pleasing results. Fig. 4 shows a desk retort house panel of this type at Bristol.

Access to Cubicles.

For maintenance and other services to the equipment mounted on or in the panel, ease of access must be considered in the design stage. Normal depth cubicles of 1 ft. 6 in. are provided with removable covers for rear-access. Side-access applies if the panel is installed against a wall. When the size of the panel necessitates actual entry of personnel for servicing, a 2 ft. minimum depth is required and doors are included. Similarly, large panels installed as free standing units should also have lockable access doors at side or rear. Interior lighting is a desirable accessory in the interest of efficient servicing.

Vibration.

Industrial instruments are constructed to withstand a certain amount of vibration, but in some cases the reasonable limit

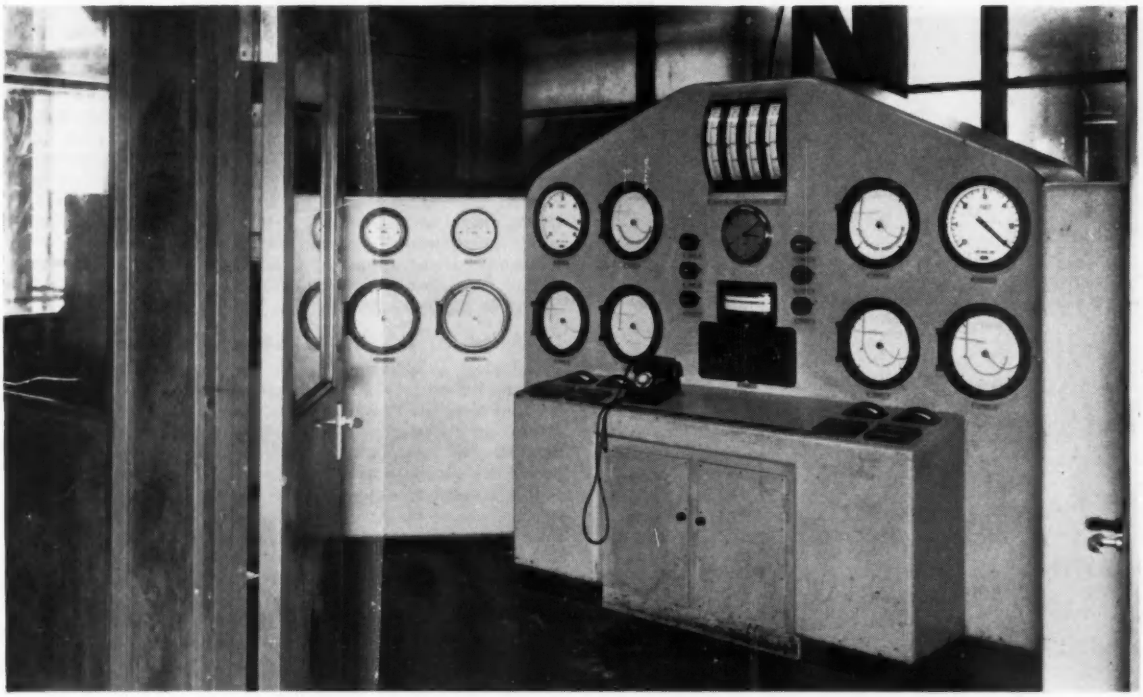


Fig. 4. Retort house panel at Stapleton Road, Bristol, gasworks (South Western Gas Board).

is exceeded due to an amplification produced by panel mounting. Several sizes of anti-vibration mountings are available. These must be distributed around the cubicle base for uniform loading. The appearance of all floor mounted panels is much improved by erecting on a 4 in. high concrete or brick plinth. Also this protects the panel base from damage by kicking.

Internal Wiring.

The complexity of interior connections between entries and instruments, switches, signal lamps, controllers, fuse boxes and sundry other equipment, necessitates an orderly layout. Again, this is in the interests of subsequent servicing or alteration. Electric cabling is supported in perforated trays. Cable ends are identified by clearly marked or coloured ferrules. Alternatively, the wiring is colour coded in order to avoid confusing the circuits.

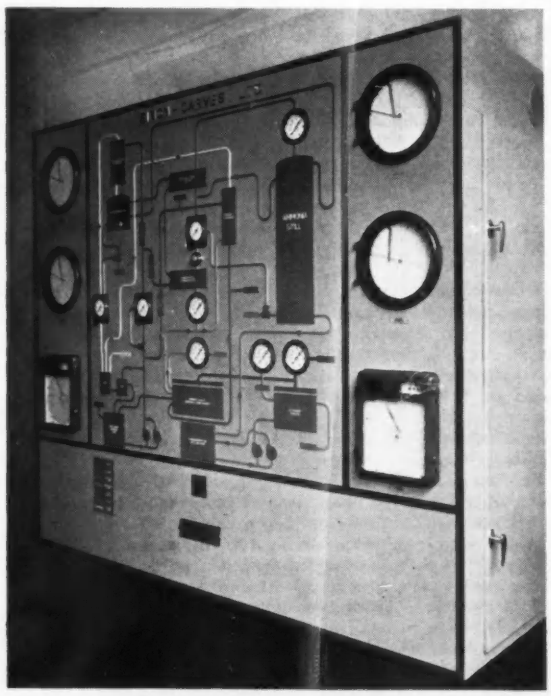


Fig. 5. Graphic panel for a concentrated liquor plant.

Terminal blocks are provided for outgoing connections. Each block is fitted with an engraved title plate identifying the equipment group it is serving. Electrical services enter the panel through suitable fused isolators and are sub-divided into individual circuits through multiple distributor boards.

Thermo-electric wiring, i.e., pyrometer compensating cable, presents its own particular problem. Special gland plates are provided adjacent to the reading instruments where cable ends can be soldered and thermocouples connected in series or parallel as required.

Safety factors are very important where there is human access to a cubicle. All live parts are adequately shrouded to prevent accidents. Terminal blocks may be provided with transparent plastic covers. Appropriate 'danger' notices are displayed.

Internal Piping.

Internal piping is carried out in steel for steam, corrosive fluids and gas connections, and in copper for air, clean gas and water, etc. Steam gauges are isolated by valves separately bracket mounted to facilitate removal for repairs or testing. A number of isolating valves may be banked for neatness. The incoming pipes are screwed direct into the isolating valves or run to a gland plate and terminated in a compression-type bulk head union. For higher pressures, the isolating valve is of the flanged type, and fitted with an inspection gauge connection. Finally, all pressure piping is hydraulically pressure tested at 1½ times working pressure.

Light and heavy gauges of copper tubing are supplied for air pressure up to 100 lb. per sq. in. from compressors, or at 15 lb. per sq. in. for pneumatically operated equipment, water connections and draught gauge connections. Compression type unions are employed throughout. Drip trays are fitted below all pressure measuring instruments to convey fluids away to a drain and protect the electrical equipment underneath.

Testing.

An important operation in panel manufacture is the final

test of all electrical circuits. Flash tests to earth are made at 1,000 V. Some users undertake a final inspection of control panels before acceptance. Among these are the British Electricity Authority, certain plant makers and agents for overseas clientele.

Colour and Finish.

Industry has followed the trend in display and public-building technique in becoming increasingly colour-conscious. Psychologists explain that fatigue and depressive effects are caused by certain colours, by undue contrasts, or by 'sameness.' The relaxing effect of pastel shades is widely appreciated. Colour schemes, relaxing and pleasing to the eye have been applied to power station control rooms for many years. The practice has extended to exhauster and compressor houses in the gas industry.

Nevertheless, the gas industry, until recent years, has tended to favour black panels and black instruments. There is a growing inclination, however, to accept shades of grey with, perhaps, a border trim of a contrasting shade. Manufacturers are usually prepared to finish in any colour to conform with a general scheme; though British Standard colours are preferred. The employment of such standards also simplifies matching and retouching (see Table I). British Standard Colour Cards are available from H.M. Stationery Office at 5s. each.

TABLE I
Usual Colour Combinations

Panel	Instrument Bezels	Border or Section Trim
Black matt or gloss ..	Black matt or gloss ..	Black, usually contrast to panel, matt or gloss.
Light grey matt or French grey matt	Lead grey or dark grey matt	Dark grey or chrome.
Light grey	Black matt or gloss or dark grey matt or gloss	Black or chrome or same as instruments
Light green (eau-de-nil)..	Dark green gloss ..	Same as instruments.
Light blue	Dark (royal) blue ..	Same as instruments.
Black crackle	Black matt or gloss ..	

* The use of chrome is not advised in gasworks except for offices or remote distribution control rooms.

Steel panel faces are rubbed smooth with pumice-stone and treated with an anti-rust compound before spraying and stoving at 250°F. Matt or polished finishes are available, the latter being somewhat easier to clean. Crackle finishes, once in fashion, are very difficult to keep free from the effects of dust.

Polychromatic finishes have a pleasing metallic lustre and may be applied to less well prepared surfaces. Sindanyo-board faces retain their high polish indefinitely and are not subject to damage by chipping as with painted surfaces. But only black and brown finishes are available.

Exterior Lighting.

Exterior floodlighting of panel faces is generally considered to be superior to the internal lighting of translucent instrument scales. Small panels are adequately lit by an incandescent lamp in a 'gooseneck' fitting, surmounting the top or suspended from the ceiling. Larger display areas are more efficiently lit by fluorescent lighting either suspended in individual fittings or incorporated in a steel canopy over the cubicle. A canopy adds little to the cost and may be fitted after the panel is installed.

Graphic Panels.

A diagrammatic layout of a plant may greatly assist attendants in supervizing and analyzing the operation of continuous processes. This applies particularly to the more complex plants with high throughputs and low surge capacities. In such circumstances, the indication and recording of process variables located at the appropriate points in the process diagram enables trouble to be spotted and immediately identified with the plant unit concerned.

The growing use of miniature instruments, permits considerable saving in panel length and, therefore, smaller control rooms. The graphic panel incorporates these instruments most effectively, together with remote setting stations for automatic control of the process. It is a development of far reaching importance. Fig. 5 illustrates a typical panel built for a Simon-Carves concentrated ammonia liquor plant and which represents the most up-to-date practice for this process. Graphic panels of usual types are produced in two general ways:—

(1) A flat plastic surface with coloured design 'inlaid,' i.e., 'Warerite' or 'Formica.' This provides an easily cleaned and permanent surface. Any future changes to plant layout cannot, however, be incorporated in the graphic panel face.

(2) Three dimensional representation by plant symbols and flow lines superimposed and secured on to the panel surface. This method has the advantage of flexibility in addition to a pleasing appearance. Future alterations to plant can be readily accommodated on the graphic panel by the user. Plant symbols for pumps, valves, condensers, and a considerable range of auxiliaries, are moulded in plastic to British Standard shapes and coloured accordingly.

The graphic panel is designed for a complete and continuous process rather than for a single operation. Ammonia liquor concentration and benzole plants are very suitable for graphic panel treatment and several are being made for installation by gas boards. On the (Simon-Carves) panel illustrated, the process is automatically controlled through 'remote setting stations' mounted in the flow diagram in their proper positions. Facilities are provided for the operator to change from automatic to manual control (or vice versa) of the variables concerned and to compare instantaneous values with the set points.

The graphic panel, incorporating compact, 'bantam' size instruments, is a progressive development of centralized instrumentation and automatic control. Generally an economy is effected in the reduced length of the panel and the size of control room. The pictorial representation of the process greatly eases the training of operators, makes supervision simpler and reduces the number of operating personnel required.

The photographs used in this article are reproduced by courtesy of the Woodall-Duckham Construction Co., Ltd., Simon-Carves, Ltd., and Electroflo Meters, Ltd.

NUCLEAR ENERGY CONFERENCE

In the light of developments in the technology of nuclear energy, and the increasing demand for a common ground between scientists and engineers where these developments can be discussed, an organization has been formed by the Institutions of Civil, Mechanical, Electrical, and Chemical Engineers, and the Institute of Physics, to satisfy this need. This will be known as the British Nuclear Energy Conference, whose affairs will be managed by a board consisting of three representatives from each body. The Chairman is Sir Christopher Hinton, and Sir John Cockcroft is one of its distinguished members. The Secretary is Mr. Alexander McDonald (Secretary of the Institution of Civil Engineers, Great George Street, S.W.1), the five societies will arrange for the presentation of papers dealing with nuclear energy subjects, and all members will be able to attend.

The Conference will publish a journal about four times a year containing records of the papers, discussions, symposia, and conferences conducted by the board. An inaugural meeting will be held in the autumn. The Board proposes to promote national and international conferences from time to time, and to arrange for British participation in international meetings.

DETECTION OF CARBON MONOXIDE

The third edition of *Carbon Monoxide*, Leaflet No. 7 in the series *Methods for the Detection of Toxic Gases in Industry*, has been published by the Stationery Office (9d., by post 10½d.). The leaflet describes the places where the gas is likely to be present and the ways in which dangerous concentrations can arise. As the gas is colourless and odourless it can be most insidious and concentrations as low as 100 parts per mill. can cause mild symptoms of poisoning to anyone continuously exposed to them. Canister respirators, including civilian and service types, are not effective against carbon monoxide. The leaflet describes the method of detection, the use of indicator tubes, and the safety precautions to be used when making the tests. It is emphasized that if an operator has to enter a confined space to make a test he should wear either a breathing apparatus with self contained oxygen supply or one supplied with fresh air from an uncontaminated source.

INSTRUMENTATION IN GAS DISTRIBUTION NETWORKS

A STUDY of gas distribution systems existing some five or six years ago showed that a majority had been developed by individual, isolated gas undertakings to meet their own particular requirements. In consequence, whereas the results achieved were sometimes similar, the methods employed varied widely and the amount of instrumentation required or used was very small.

With the integration of the gas industry and the consequent elimination of inefficient production plant, has come the realization that control from a central point is indispensable to efficient and economical operation of modern gas distribution schemes. The control must be such as to ensure that each station in the system is supplied with an adequate amount of gas to meet its own particular load, and that the mains system operates at as near 100% load factor as possible. In addition, peak demands on feeder mains must be minimized by taking full advantage of district storage, allowing the plant and mains to be operated with a high load factor throughout the 24 hours.

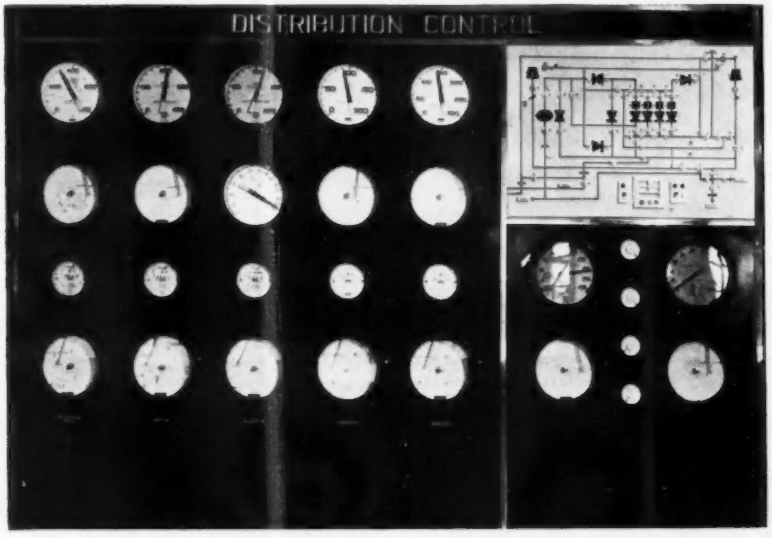


Fig. 1 (above). Distribution section of a large works control panel.

Fig. 2 (right). Boosters, governors and non-return valves at the Formby distribution station, with instrument panel rear left and supervisory control cabinet centre of rear.

Transmission of gas may be divided broadly into two types:—

(1) The supply of gas from manufacturing stations to holder stations by either common or separate feeder mains.

(3) The transmission of gas in bulk between manufacturing stations.

For the correct operation of a gas distribution network or grid system receiving its gas from one or more manufacturing stations for transmission to a number of holder stations, some form of instrumentation is essential for efficient and economic operation.

At the manufacturing stations, the following information is desirable:—

(1) Inlet and outlet pump or booster pressure, indication and record.

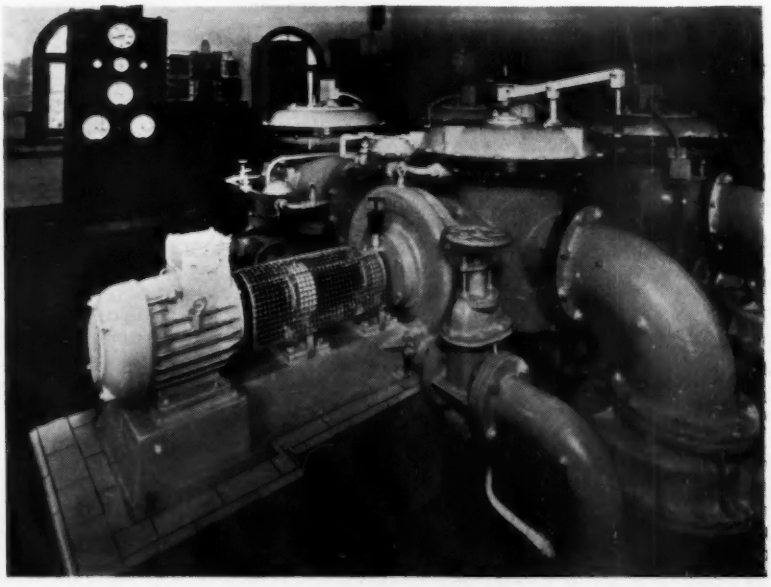
(2) Indication, record and integration of gas flow on each outgoing transmission main.

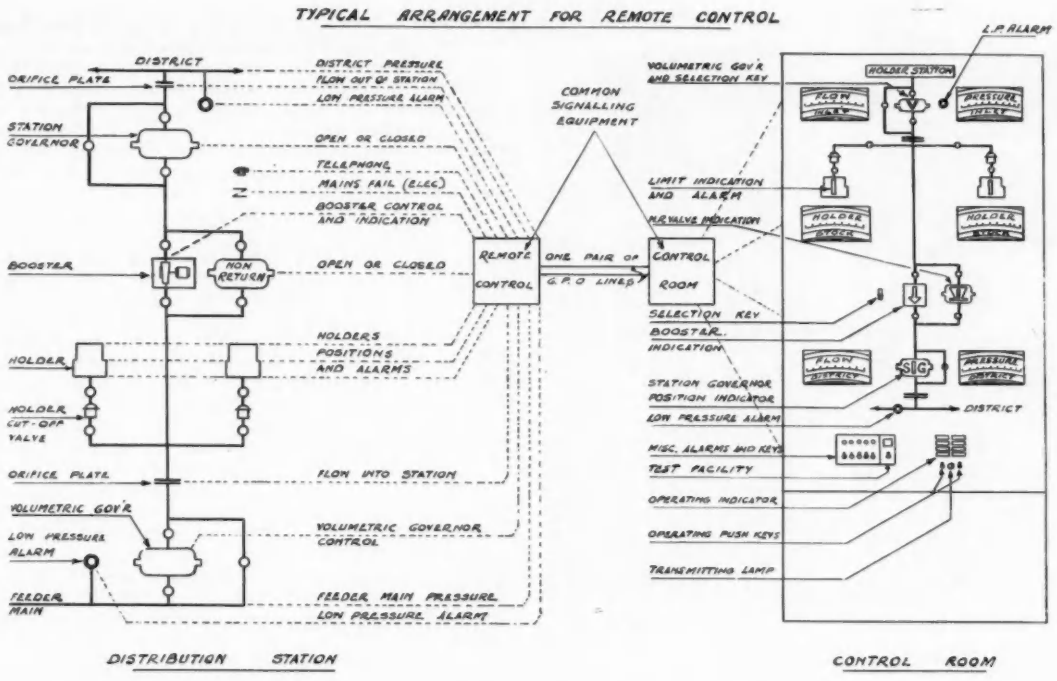
(3) Indication, record and integration of gas flow on each local delivery main.

All these instruments should be collected together at one point on to a panel incorporating a schematic diagram of the distribution mains system within the works. A typical distribution panel at a manufacturing station is shown in Fig. 1. The panel should be in a position where the person responsible for gas movement—a valveman, booster attendant or control engineer—can readily see the information constantly displayed so that he can make any adjustments required.

For holder stations, the information required is very similar to that needed for the distribution section of a production station with the addition of pressure and flow information on the transmission main at the inlet to the holder station. The flow instrument in such cases is generally associated with the volumetric governor and with the grid main pressure taken from the inlet to the volumetric governor. Flow meters of the inferential type are invariably used in conjunction with an orifice plate, ring balance and associated electrical indicating recording and integrating instruments. The majority of holder stations are operated by an attendant or attendants working on shift, and acting on instructions issued from some administrative centre.

The most remunerative field for the introduction of instrumentation in gas distribution is its application to gasholder stations in conjunction with remote control. (Fig. 2.) Where the station is manned for either two or three





shifts per day and the duties of the operatives are purely for the control and movement of gas in or out of the station, then such labour can be dispensed with by controlling the equipment remotely.

In order to operate such a system efficiently, facilities must be available to give the control engineer at the control centre all the information he requires for each of the stations under his control, and to provide him with the means of altering the conditions at any one of them when required. It is appreciated that each station must be planned individually, but the facilities which are available and indicated below are sufficient for the control of most holder stations. (Fig. 3 above.)

(1) The remote indication of pressure at the inlet to volumetric governor or control valve.
(2) The remote indication (and integration if required) of the flow through the volumetric governor into the station.
(3) The remote control of the volumetric governor or control valve.
(4) The remote indication of the gasholder stock, with audible and visible alarms for high and low limits at, say, two plates from full and two plates from empty.
(5) The remote indication of the district pressure, outlet of station governor.
(6) The remote indication (and integration if required) of the district flow on the outlet of the station governor.
(7) The remote control and indication (either running or stopped) of the station booster.
(8) The remote indication and alarm of low pressure conditions on inlet to volumetric governor.
(9) The remote indication and alarm of mains electricity supply failure at the station.
(10) The facility for testing the equipment.
(11) Telephone communication.

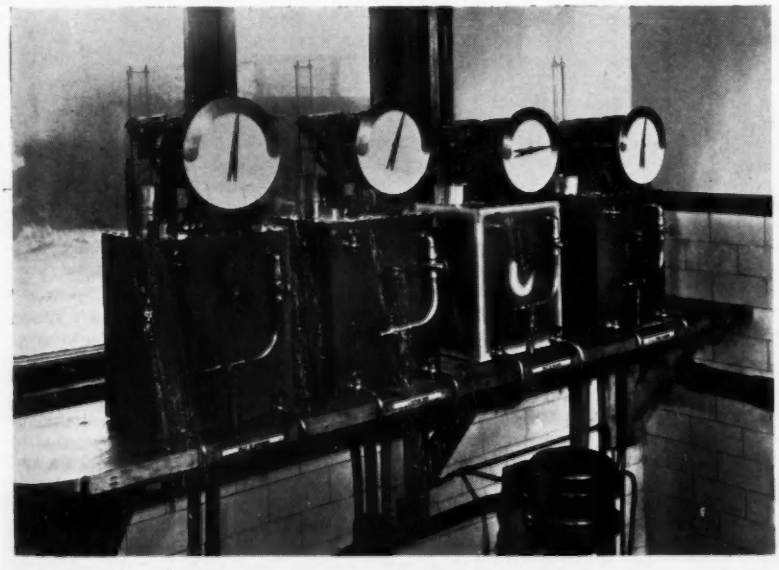


Fig. 4. Prototype pressure transmitting coders first installed at Formby in 1944.

The control engineer, with these facilities at his disposal, knows exactly the conditions at each of the holder stations in his area. Therefore, knowing the stocks and input and output flows, he can make the necessary adjustments at a station according to its own characteristics, and at any other station which may operate in conjunction with it. The electrical system used for this control and transmission of information is of the supervisory remote control type, generally using a pair of rented G.P.O. telephone lines linking the distant station with the control centre. Similar equipment to this has been in use for some 30 years in the field of electrical generation and distribution, and is widely used for control on the British grid system.

Prototype equipment of this type, as now applied to the gas industry, was first installed at the Formby distribution station of the Liverpool Undertaking in 1944, and has from that date been entirely satisfactory and completely reliable. (Fig. 4.) The readings for gasholder stocks, pressures and flows at the control centre are continuously indicated on suitably calibrated electrical instru-

Fig. 5. Showing, left, front view and, right, rear view of pressure transmitting coders installation.

ments. The height of the holder is measured by means of a coding device which converts it into an electrical equivalent for transmission over the G.P.O. wires. (Fig. 5.) Associated with the stock readings are limit alarms which are given at the control room by the ringing of a bell and the lighting of coloured lamps on the central panel. The alarms are not initiated by the coding device but by trip switches actuated by bars fitted on the holder itself. The transmitting instruments used for pressure readings are a form of King's gauge or manometer incorporating a coding device similar to that used for holders. The method of transmission of flow readings differs from the former in that this information is taken from the electrical equipment associated with the orifice plate meter.

When it is necessary to alter the setting of a volumetric governor, or stop or start a booster, the control is carried out in two stages:—

(1) The selection of the operation, and

(2) The operation itself.

This is done with a view to reducing the danger of accidental operation to an absolute minimum. To operate the volumetric governor, the appropriate key is first selected and this is followed by either a 'raise' or 'lower' operation. Either of these is effected by momentarily operating a push button on the control panel. The circuits are designed so that the operation of the appropriate button transmits information to the holder site which results in the alteration of a cam associated with the volumetric governor. One 'raise' or one 'lower' operation alters the governor in such a way as to change the flow of gas by a known amount.

To stop or start a booster, the control is again two-stage, and the booster operating key must first be selected on the control panel, followed by the operation of the start or stop button. At the remote site, on receipt of the control signal, the equipment is arranged by means of special telephone-type interposing relays, either to start or stop the booster according to which button has been depressed at the controlling end. The method of control of a motorized valve is almost identical with that of a booster.

Low pressure alarms may also be provided at the control room to indicate low pressure in any part of the system at the holder station. Each alarm is initiated from a diaphragm-operated device fitted with suitable electrical contacts. The occurrence of the alarm is indicated by the lighting of a lamp on the control panel and the ringing of an alarm bell. Telephone communication is provided between the remote holder station and the control room, the telephone handsets being of the standard type used in normal practice by the Post Office.

There is no doubt that the judicious use of centralized control for a gas distributing network can assist in reducing costs, especially when coupled with remote control of the distributing plant. Although the largest remotely controlled station (Eccles Street, Liverpool) known to be in operation has an output of some 1,400 mill. cu.ft. per year, yet the output of a station does not limit the application of remote control, particularly where the pressure-raising plant at the controlled station is of the centrifugal or booster type.

It has been found that there are two main objections to remote control, and these are the ill-founded suspicions on points of security and cost. The personnel of one large control room who have operated several remotely-controlled holder stations, and monitored the gas movement between a number of manufacturing and distributing stations for many years, can say quite conclusively that they have never had any reason to doubt the information displayed before them in their control room. Furthermore, although when the security angle is considered, it would be idle to say that the G.P.O. lines have never failed, yet on the rare occasions when this has happened the control staff have known immediately and have been able to deal with the matter.

In the electrical field, a good example is the remote control of the Galloway hydro-electric scheme in Scotland where two generating stations are both controlled entirely from a remote point some miles away, using rented Post Office lines. The remote operations include the starting of water turbines, regulation of the speed and excitation, synchronization, and the operation of circuit-breakers; in addition, telephone communication is provided and remote indications are given of water levels, meter readings, water intake gate, and valve position, alarm signals of high generator temperatures, lubricating oil flow, etc. The remote control equipment which was installed for the purpose has given entire satisfaction for over 15 years.

As for cost, one might consider a gasholder station manned for 24 hours a day. The actual attendance required on the station is some 1,095 shifts per annum, but holidays and the incidence of the six shift week mean that to achieve 1,095 shifts one pays for 1,366 shifts, and at 32s. a shift—a normal sort of rate—this works out at £2,186 a year. To this must be added sick pay, National Health, and so forth, bringing the figure up to £2,350 a year. If this figure is offset by the £400 a year repair and maintenance charges, it is reduced to some £1,950. The cost of remote control for a two holder two booster distributing station is in the order of £7,500, and to spend this amount to achieve an economy of £1,950 per annum surely must be a good investment. This short article does not go into any detail, but indicates that instrumentation must form a part of any distribution network if an adequate and economical control is to be maintained.

O.E.E.C. AND AUTOMATION

The use of automatic production control processes and the progress made in the manufacture of electronic computors have recently been investigated, under the auspices of the O.E.E.C. European Productivity Agency, by a group of European technicians, sociologists, and trade unionists. The group decided to undertake an enquiry on these problems among member countries. During the next three months, these countries will report on conditions with regard to automatic techniques in their industries and the prospects which these techniques seem to open up. On the basis of this information, the group will fix the date of an international symposium.

In their discussion the technicians of the group were unanimous in emphasizing that the evolutionary nature of automation techniques has been speeded up by the progress of electronics during and since the war, and that the principles involved go back to Jacquard's loom and Watt's governor. The sociologists, for their part, pointed out the revolutionary possibilities of electronic computing machines when applied to the new techniques coming under the headings of statistics and operational research; these possibilities open up prospects in business management which were previously quite unknown. The results of the survey will enable the European Productivity Agency to gauge the scope of the technical, economic, and social problems raised by the introduction of automatic processes and to discuss them at international level.

Instrumentation of the Carbonizing Plant

M. S. Gaskill, Technical Director, and T. A. Tomlinson, Consulting Engineer,
West's Gas Improvement Co., Ltd.

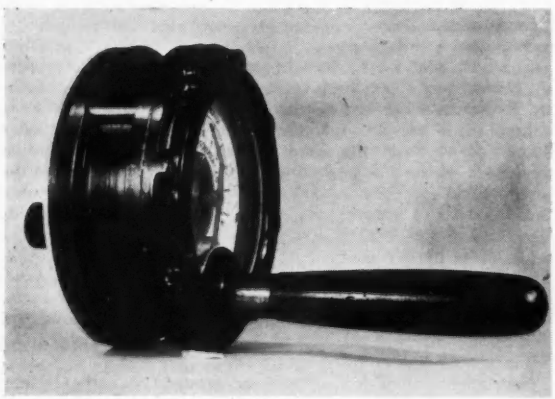
FOR the control of the modern carbonizing plant and the maintenance of operational efficiency it is necessary that the responsible personnel shall be provided with the means of observing and measuring temperature and pressure conditions at every significant point in the installation.

Instruments may be classified under the two headings: portable instruments and fixed instruments or instrument panels. Portable instruments, of the indicating type, are used by the plant operator in the control of the required conditions. Fixed instruments, both indicating and recording or integrating, provide the management and technical staff with, in the first place, information relating to existing plant conditions, and in the second, with a continuous record of variations in operating conditions and measurements of such measurable quantities as fuel, water, steam and air flowing to and through the plant; to these may be added CO_2 recorders connected to suitable points.

In the selection of instruments, particularly of the portable class, it is important to recognize that portability, robustness and ease of reading must not be sacrificed to an unnecessary degree of accuracy. It is more important to note that temperature or pressure is rising or falling than to measure these quantities with precise accuracy, provided that portable instruments used 'in the field' are checked regularly against the more accurate apparatus of the laboratory.

Portable Instruments used in the retort house will be draught gauges, thermometers and thermocouples, optical pyrometers, gas analysis apparatus.

Draught Gauges are of the first importance in the control of retort settings. Regular and systematic observations of pressure conditions in all significant positions in the retort settings will give early warning of irregularity in working conditions. Changes in temperature resulting from changing vacuum or pressure conditions at some point in the system will only become apparent after a delay which may be considerable. It is important, therefore, that the operator should be provided with a readily portable draught gauge of robust construction giving rapid and easily read indications of sufficient accuracy. The instrument should not be of a type which requires setting down and levelling before use. Its accuracy should be checked, as we have said above, against a standard instrument of greater accuracy at regular intervals otherwise a slow deterioration in accuracy, unknown to the operator, may occur over a period of use.



The West-Kent portable pressure gauge.

If it should be necessary to use an extension tube from the gauge to the point at which vacuum or pressure is to be observed, the effect of the length and diameter of tube on the reading of the gauge should always be investigated before use.

In vertical retort settings, while pressure conditions in all parts of the setting should be occasionally explored there are certain points where regular and systematic observations should be made and recorded in the log book. Examples of these points are the base of the producer gas uptakes, the bottom combustion chamber, the top circulating chambers and both sides of the water-gas control dampers.

Thermocouples reading up to 7/800°C. and thermometers up to 600°C. are used mainly during the drying out and heating up of settings to ensure the maintenance of the pre-determined rate of temperature rise. They are also employed for measuring the temperature of producer gas at the outlet of the producers and at the base of the producer gas uptakes in the setting. The temperature of the gas leaving the producer is a valuable indication of the condition of the fuel bed within the producer, while the temperature at the base of the uptakes provides a rapid indication of any influx of air in the producer gas mains.

Optical Pyrometers are necessary for the observation of temperatures in combustion and circulating chambers of the setting. There are several excellent instruments available. It should be emphasized again that these instruments should be checked at regular intervals against a standard instrument. An important point in the use of the optical pyrometer is the 'personal equation.' Every user should, when possible, check his readings against those of another, and if possible more experienced, observer.

Gas Analysis. It is sufficient to say here that the standard portable Orsat apparatus is the one most suitable for the regular necessary analysis of producer and waste-gases. Producer outlet, waste-gas outlet from setting and inlet to waste-heat boiler are three points where regular and frequent analyses should be made, though gas analysis at any point of the system may be of value in tracing leakages and general irregularities of working.

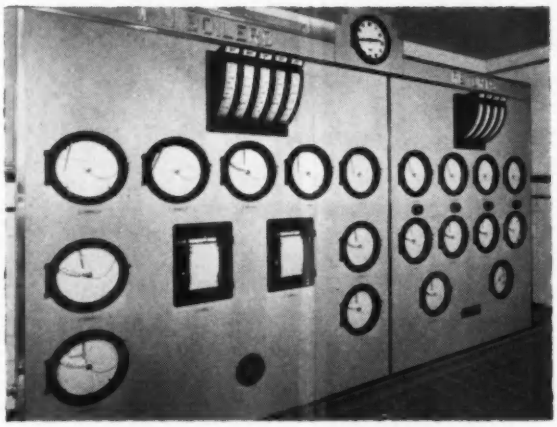
Care of Portable Instruments. Experience indicates that it is necessary to remind operators, particularly junior members of the technical staff, that these instruments are not only portable but 'damageable.' Many valuable instruments are damaged and their useful life shortened by being left after use in an unprotected condition or unsuitable position. Proper storage should be provided for all instruments to which they should be returned immediately after use. Here they should be inspected by a competent person, cleaned and minor defects remedied immediately on their return to store.

Fixed Instruments. The selection, mounting and siting of fixed instruments has received a good deal of attention in recent years and a wide range of suitable apparatus is now available. No attempt is made here to describe individual instruments but rather to define the types of instrument to be used and their arrangement on suitable panels.

Instruments are of three main classes: indicating, recording, indicating and recording or integrating. Arrangement falls into three categories: individual, where a single instrument is fixed at a definite point: grouped, where a number of instruments all relating to a particular section of the plant are mounted together: centralized, where a number of instruments are mounted on a main panel located in a central control room or position, the instruments in this case relating to the plant as a whole or a substantial part of it.

Practice in the adoption in whole or in part of these categories has varied considerably. 'The temptation to centralize instruments to produce an impressive control panel should, generally speaking, be resisted. The position, particularly of indicating instruments, should be such that each instrument yields its maximum value in the control of the related operation. The best position is normally where the instrument can be seen with the minimum of effort on the part of the plant operator and close to any controls which may re-

quire to be adjusted in accordance with the indication of the instrument.'* At the same time it may be well in some cases to duplicate an instrument on the control panel so that the



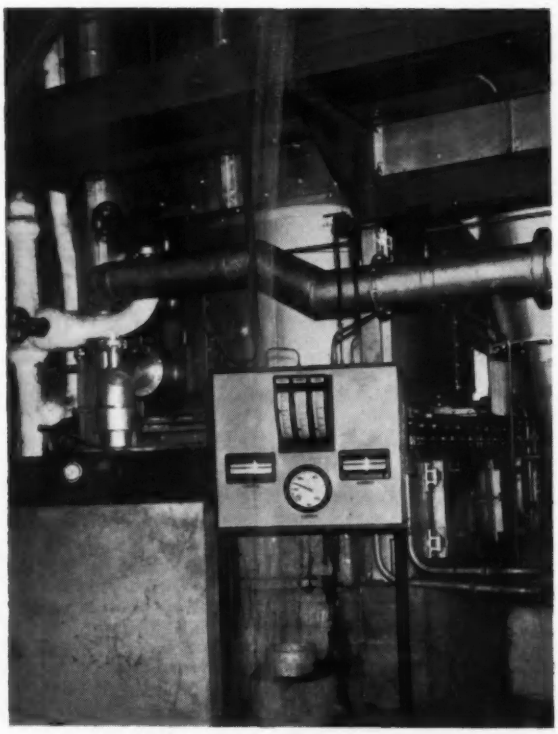
An instrument panel in the retort house.

operation can be followed in the central control room. Recording instruments usually require more protection and maintenance than indicators and should therefore be selected for the central control panel. Following is a brief schedule of instruments which have been provided for a recent carbonizing plant:

(a) *Producers.*

Each of the ten mechanical producers is provided with a panel upon which are mounted:

Steam/air temperature indicator, range 0°-100°C.; air flow indicator to measure air supply to producer range 500-1,750 cu.ft. per minute; draught indicator showing vacuum under



Control for mechanical producer.

grate, range 0 in. to 6 in. w.g.; draught indicator showing pull at exit from producer, range 0.5 in. to 0.5 in. w.g.; temperature indicator showing temperature of producer gas leaving the producer, thermo-electric type, range 0°-1,000°C.; and temperature indicator for automatic control showing temperature of ash bed, thermo-electric type, range 0°-500°C.

In addition there are two panels placed on the retort house wall between the two groups of producers, indicating and recording conditions in the common producer gas flues. On each panel are mounted:

A 12 in. dia. pressure recorder, range—0.2 in. to 0.2 in. w.g.; an electrical transmitting indicating CO_2 recorder, range 0 to 20% CO_2.

(b) *Gas Offtake and Retort Conditions.*

On the top of stack between the two sections of the retort house is a main panel upon which are mounted the following:

One 36-point temperature indicator with connections to each of the 32 gas collecting mains (4 spare points), range 0-500°C.; one 4-point temperature recorder with connections to foul mains from each retort bench; Sigma recording calorimeters with filters connected one to the foul main from each retort bench; four pressure indicators, one to inlet of each retort house governor, range −1 in. to +1 in. w.g.; four vacuum recorders, ditto; four vacuum records, one to outlet of each retort house governor, range 0-6 in. w.g. vacuum; to each retort house governor a vacuum indicator, range 0-6 in. w.g. vacuum, is fitted to the connection between foul main and pilot governor and mounted locally.

(c) *Steam to Retorts and Liquor Sprays to Gas Offtakes.*

Instruments to control these services and mounted on the same panel as group (b) are:

Four integrating and recording steam flow meters, one to each bench; one level indicator-connected to the liquor tank; mounted locally at producer platform level are four 12 in. dia. steam pressure gauges, one to the steam supply of each bench and two 12 in. dia. liquor pressure gauges, one to each pump house. There are also smaller steam gauges fitted at inlet and outlet ends of the steam lines to each retort bench.

(d) *Waste Heat Boilers.*

In each of the two boiler houses is a panel upon which are mounted:

Three draught indicators, one to each boiler outlet, range 0-6 in. w.g., vacuum; three 3-point temperature recorders, one to each boiler, with leads to boiler gas inlet and outlet and steam superheater, range 0°-1,000°C.; one feed water temperature recorder, range 0°-250° C.; three integrating, indicating and recording steam flow meters, one to each boiler on the steam outlet.

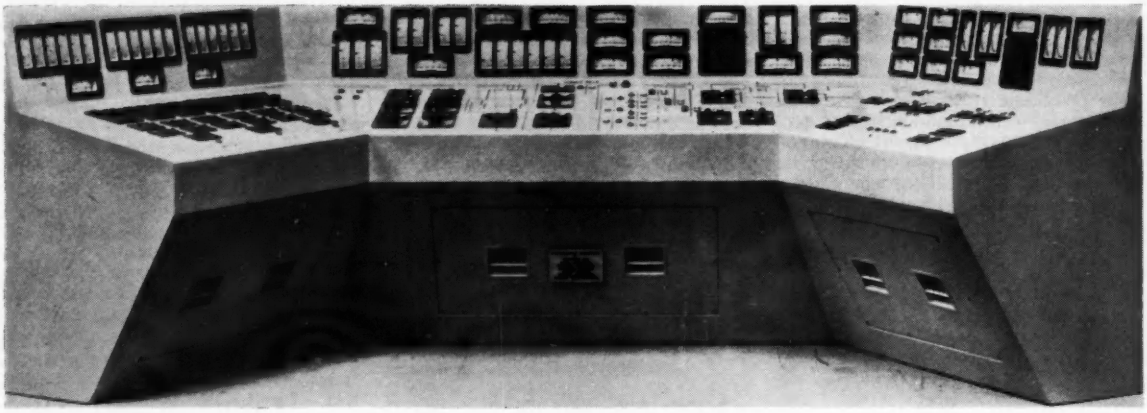
Mounted locally are:

Draught indicators, draught recorders and CO_2 recorders on the waste-gas flue from each retort bench.

'While an adequate number of suitable instruments is invaluable for correct operation, over-elaboration and instruments merely for the sake of instrumentation should be avoided. At the risk of stating the obvious it may be said that instruments are only of value to the extent to which their indications and records are used. To ensure full use, the significance and use of every instrument should be clearly understood by all concerned and instruments should at all times be properly maintained—Charts from recorders should not, as has been known to happen, be filed as soon as they are removed from the instrument but should receive full consideration by a competent person and should form part of a properly organized scheme of plant control.'*

Instruments sited individually or grouped near the related plant should be adequately illuminated by day and night. Particularly where instruments are grouped or centralized great care is required in the design and erection of the necessary connections between points of measurement and instruments. Piping should be of ample bore and freed from rust, scale or dirt before erection. Copper is generally preferable to iron piping. Provision should be made for cleaning all piping by rodding or blowing out. Where there is any possibility of condensation, drains suitably sealed should be arranged both to prevent pipes becoming filled with condensation and to avoid any risk of the liquids entering the instrument When instruments are connected to flues or mains containing foul gas—*i.e.*, gas containing tar or oil vapour, compounds of sulphur, dust, etc., a small continuous supply of clean gas should be introduced into each gauge pipe, through a suitable 'bubbler,' as close to the instrument as possible. This will prevent foul gas entering the instrument, an important point particularly with gas containing tar vapour since should tar enter certain types of instruments it not only renders them useless, but is difficult to remove.

* M. S. Gaskill, "Fuel Economy in the Gas Industry" (May 1952)



This console desk by Bailey Meters and Controls, Ltd., controls a power plant. It might be a symbol of the 'Push-Button Age.'

BRITISH INSTRUMENTS AND MODERN INDUSTRY

Instrumentation and Automation at Earls Court

The wonders of the scientific age have made the robot a reality, not in the shape of the creature of science fiction, but in the far more diverse form of the scientific instrument and automatic control which brings to every industry the opportunity of increased production, with better quality products, lower overheads, better working conditions, and more efficient laboratory research.

At the British Instrument Industries' Exhibition, staged at Earls Court, London (June 28 to July 9), the research worker and industrialist can study the application of these automatons, the products of some 160 of the finest instrument makers in the world.

Higher Production

Instrumentation and controls are important to every industry by providing means for research and for establishing and maintaining optimum working conditions, thereby securing increased and cheaper production and higher and more consistent quality with less wear and tear on plant. This exhibition offers the industrialist an opportunity to examine the latest methods and equipment which are now at his disposal. The exhibition is sponsored and actively supported by the following Associations: The British Electrical and Allied Manufacturers' Association, the British Industrial Measuring and Control Apparatus Manufacturers' Association, the British Lampblown Scientific Glassware Manufacturers' Association, the Drawing Office Material Manufacturers' and Dealers' Association, and the Scientific Instrument Manufacturers' Association of Great Britain.

As an indication of progress being made in the instrumentation field, take the following: The 'electronic brain,' or electronic digital computor, now produced commercially as standard equipment, shows how diverse and complicated mathematical problems can be completed in one hour against the *two years* taken when using conventional methods. Then there is the 'Stroboscope,' with which the movement of rapidly moving machines and articles can be 'killed'; the rotor of a dynamo can be studied just like a still photograph, while working at thousands of revolutions per minute. A newspaper can be read while revolving on the machines at high speed. There is a robot apparatus for the detection and measurement of smoke and of 'smog,' at the same time enormously increasing boiler efficiency. Flame failure apparatus show how alarms and signals can be automatically brought into action if the firing of boilers should fail. And we saw a balancing machine so accurate that the gravity of shafts and rotors can be balanced to about 5-millionths of an inch, and a sound level meter that will detect sound so quiet that it would need an area as large as Great Britain to collect enough sound energy to light a 60-watt bulb; yet this same meter will measure the ear-shattering din from a jet engine.

The important scientific glassware industry is well represented with some of the latest types of products so necessary to the scientific worker. The handling of newly discovered chemical compounds and radio-active materials has called for new types of glass, new precisions in manufacture, and still greater variety of apparatus. Exhibitors show that the age-old skill of the glass blower has been married to requirements of modern production methods, and the ranges of scientific glassware now placed on the market have brought Britain to a leading position in world markets. Among the many new types of scientific glassware there is a heat-resisting brand in which radioactive isotopes can be despatched.

Drawing office equipment includes a new 'Planimeter' which gives the area of an irregular figure in a minute or two without requiring any special knowledge or skill. Another manufacturer exhibits special pencils with light-excluding properties enabling photographs to be made direct from pencil drawings.

Some of the automatic process and power station control apparatus on view is too difficult to describe to any but the technician, but it can do the work of a whole team of engineers—watching for faults, recording output, sounding alarms at any failure, rejecting imperfect products—in fact, the 'mechanical brain' on which industry will in future rely for its efficiency, far beyond the ideals of the past decade. Oil refineries and modern processes in the chemical and other industries are now literally built round automatic control equipment of the type on show.

Time Saving

There is a series of photo-electric devices which will measure the gloss of paint, and give it colour composition, measure the growth of bacteria while still in their test tubes, and reduce the time taken for difficult chemical analyses, from *two days to one hour.* Industrialists will find new heating mantles and tapes allowing working temperatures of no less than 800°C.

The latest types of cathode ray oscillograph are proving of outstanding interest both to the industrial and medical worlds. These instruments not only measure pressure, vibration acoustics, etc., in the engineering phenomena, but record the minute potentials developed by the brain, heart muscles and nerves of human beings.

For those engaged in the measurement of electric current there is a device that can be clipped on the *outside* of a live cable which will give the current pass-

ing through and the voltage. These readings can, of course, be obtained without interruption to the supply, and are equally effective with a fractional horse power motor as with heavy duty installations. Ultrasonic flaw detection has been perfected to the point where the examination of materials from $\frac{1}{16}$ in. to 20 ft. thick can be carried out rapidly and with absolute accuracy.

These are some of the wonders on view. But we are primarily concerned with the gas industry and in this field the development is no less remarkable. Among the many instruments and controls for the gas industry is a new gas distribution calculator which simulates the flow of gas in town gas distribution systems, using electric current and resistances. This enables the gas engineer to set up an imaginary distribution system and to calculate the exact requirements in pipe sizes, gas pressures, etc., for a given demand. Another exhibit of interest to the industry is a new system of recording the rate of flow, gas pressure, holder height, etc., over any distance, and the remote control of the system can be operated over the same pair of wires. Related to the gas industry, and for those engaged wherever noxious gases or fumes are likely to be present, is a new automatic alarm system that gives visual and audible warning when dangerous conditions have been reached.

All this is by way of introduction. In the following review we have selected what we consider to be the outstanding exhibits in an exhibition which, although not large by present day standards, is unique in the influence it exerts on British industry and the national economy.

Lectures and Conferences

Before dealing with the stands, however, mention must be made of the lectures and conferences being held during the exhibition's run. On June 29 those present heard a paper on 'Instrumentation as an Aid to Fuel Efficiency', by R. Clare, Deputy Area Engineer of the North Western Area, National Industrial Fuel Efficiency Service. This covered the principle of operation and applications for efficient steam generation, smoke elimination and heat utilization, and dealt with minimum instrumentation and the advantages of complete instrumentation. On June 30, 'Instrumentation and Nuclear Energy', with its applications, was described by Denis Taylor, of the Atomic Energy Research Establishment at Harwell.

On July 1 the Society of Instrument Technology arranged a general meeting to which all visitors to the exhibition were invited. Discussion centred on training and education for instrumentation and automatic control. July 4 brought 'Future Applications of Digital Computors', by H. McGee Rose, and July 5, 'Photocopying and Reproducing in Industry', in which the speakers were H. R. Verry and A. B. Baker. Today 'The Economic Level of Instrumentation in Boiler Plants' forms the subject of an address by Gabriel P. Clay, followed by 'Smoke Reduction and Fuel Efficiency by Measurement and Control', by Rear Admiral Sir Sidney Frew. On July 7 the subject will be 'Open Hearth Furnace Control', an address by E. Whitehead, and on July 8 there is the S.I.M.A. annual general meeting. A striking characteristic of the exhibition is its 'well-dressed' appearance. Clearly much attention is being given to publicity in this primarily scientific field, and the effective contemporary design of the stands reflects a realization that the instrument maker and the publicist must join forces if the best results are to be achieved.

Selected Exhibits

Airmec, Ltd., have included several new instruments in the extensive range of electronic equipment exhibited. Of particular interest are the new frequency measuring equipment, which enables any frequency in the complete range 0 to 30 Mc/s to be measured with an accuracy approaching 1 part in $10^7 \pm 1$ c/s, and the new V.L.F. signal generator type 852, which provides a sinusoidal signal continuously variable from 500 microvolts to 50 volts peak, over the frequency range 0.03 to 30 c/s.

Other instruments include signal generators, oscilloscopes, valve voltmeters, stabilized power supplies, bridge detectors, automatic voltage regulators, photocell equipment, industrial electronic counters, temperature control unit, insulation testers, frequency standard, etc.

Bailey Meters and Controls, Ltd., have an outstandingly interesting exhibit in their smoke density measuring equipment. Hitherto the method of assessing the density of smoke by visual observation of the plume emitted by chimneys has depended on the observer's power of observation, differing human judgment in observing the same plume and conditions of the sky such as blueness, rain, etc., against which the observation is being made. Furthermore, a plume of white smoke may be just as noxious as black although the former could be taken as evidence of minimum smoke density by an observer. Such a visual method is therefore likely to be unreliable.

The use of a precision instrument removes such unreliability and the method of smoke density measurement here demonstrated is entirely objective and does not rely upon an observer's power of observation. It consists of a stabilized light source projecting light by condenser lens across the stack, the light being received by a unit which contains a photocell which transmits to an electric horizontal edgewise indicator of the galvanometer type. This indicator is conveniently mounted in the plant under the observance of the operator. A strip chart recorder can be used instead of the indicator if a record of smoke density is required. If desired, both an indicator and a recorder can be coupled together in series. The instrument measures the obscuration of the light by the smoke and therefore uses, as a basis, the optical density of the smoke along the light path. It is capable of being calibrated in terms of optical density per unit length of any given stack.

Fouling of the optical surfaces by the flue gases is taken care of by the facility with which the unit can be opened once a day and the lenses wiped clean. When the unit is installed in a flue or stack where a suction exists this will allow clean air from outside to be drawn in across the lenses by means of suitable openings provided in the lens housings, thus assisting in keeping the lenses clean.

Also on the Bailey stand is a console desk incorporating miniature instruments for flow, pressure, temperature utilizing electrical transmission. The air-operated miniature control units co-ordinate with the usual Bailey automatic control system. The console is suitable for controlling a 'Unit' power plant comprising boiler and turbine of the highest output.

A new 8-in. scale draught gauge is also included, also single and multi-point temperature indicators and recorders, and combustion efficiency instruments. Bailey three element feed water controls, essential for modern industrial and power plant boilers, also combustion controls covering the latest firing methods are included.

Baird and Tatlock (London), Ltd., show as their central exhibit their new B.T.L. 'Analmatic' laboratories. 'Analmatic' is the name given to a range of automatic laboratories which are capable of carrying out a number of routine analytical processes automatically. Three new centrifuges are exhibited, the B.T.L. wide range centrifuge and the B.T.L. intermediary centrifuge, both with many interchangeable heads, the largest taking over 2 litres, and the 'Astip' oil centrifuge.

There is also a range of four new B.T.L. analytic balances, sensitive to 1/10th mg., including the 'All Weight' air damped balance with an exceptionally clear projection scale. Two other new instruments are the B.T.L. 'Elastometer' for testing the low temperature flexibility of plasticized materials and the B.T.L. mercury cathode electrolysis apparatus, designed in collaboration with the B.S.I.R.A. Other exhibits include the Karl Fischer apparatus, the Van Slyke apparatus, ovens, stirrers, micro furnaces, oil-testing apparatus, sintered glassware and laboratory glassware.

Black Automatic Controls, Ltd., have an impressive exhibit which includes representative examples of three ranges of products recently developed by this company: (a) Solenoid valves suitable for gas, oil, water, steam and other fluids —all valves are of glandless construction and include a series of two-position valves and three-way valves; (b) diaphragm-operated pressure switches suitable for high, medium and low pressures; (c) a range of thermostats for industrial applications particularly in connection with combustion control.

British Area Regulators, Ltd., include in their exhibit a full range of diaphragm-operated valves of single-seated and double-beat construction and including three-way mixing valves and butterfly valves. A series of direct-power cylinder-operated valves is also shown, together

with controllers for pressure, temperature, humidity and liquid level. Two new additions to the already wide Arca range is an indicating temperature controller and an indicating pressure controller. A complete desuperheater is also featured, together with an instrument panel, electrically-operated motorised valves, a gas regulator with oil-pump unit and diaphragm servo motors.

Of particular interest is the range of valves for which this company is well known. The majority of valves in sizes ranging from ½ in. upwards, are arranged for operation by a diaphragm servo motor. In one of two of the larger sizes, a power cylinder for water or oil is used in the case of hydraulic regulators; electric motor operation is applied to all sizes and types. In some instances, particularly for very high temperature and high pressure steam, where it is desirable that the servo motor mechanism should be separated as far as possible from the heat, the valve may be of the screwed spindle type with chain operation from an independent power cylinder; a simpler lever type of valve is also available, but limited to moderate pressures and temperatures. It can readily be seen that the servo motors referred to above, whether of the diaphragm type or of the independent cylinder type, or the electrical motor type, can be applied to any other mechanism as well as to valves. Thus, dampers, louvres, etc., are frequently controlled by Arca regulators.

The British Rototherm Co., Ltd., specialize in temperature gauges and among the types on view are bi-metallic temperature gauges, mercury-in-steel distance reading and rigid stem tempera- steel temperature records, pressure recorders, temperature controllers, thermostats, and diffusion hygrometers are among the other exhibits. This company claims that there are over 2 mill. gauges, all of the dial type. Mercury-in-ture gauges, and vapour pressure distance reading and rigid stem temperature Rototherms in daily use.

Temperature Gauges

The Cambridge Instrument Company, Ltd., has an organization which covers so wide a field of manufactures dealing with all classes of industrial and laboratory apparatus that it is divided into sections dealing with specific branches of instrumentation. The exhibit shows and demonstrates a few selected instruments representative of each section, classified as follows: Temperature measuring, engineering and physical, chemical engineering and gas analysis, and electrical measuring. Many of the instruments are new or recently modified designs and some illustrate where the introduction of electronic devices may be of service when used in connection with various applications.

C. F. Casella & Co., Ltd., together with their associated company, **Casella (Electronics), Ltd.,** show two main sets of instruments. The first is a gas-liquid chromatography apparatus by means of which microlitres of complex substances, from hydrocarbons to fatty acids, may be analyzed. As an example of its sensitivity, 1 molecule of alcohol in 50,000 molecules of nitrogen can be detected and recorded on an 11 in. wide chart. The other instrument is an automatic blood cell or particle counter, the basic principle of which is to reciprocate a slide carrying the sample through a beam of light falling on a slit behind which is a photo-multiplier. The pulses produced as the particles pass through the beam are automatically counted and so enable counts to be made more rapidly and accurately than has hitherto been possible. Also shown is a wide range of manometers, micromanometers, pressure gauges, pitot-static tubes, hygrometers, hygrographs and hygroscopes for measuring, indicating and recording pressure and humidity.

Cinema-Television Ltd., has a range of products on view which is so extensive that we cannot do more than list them alphabetically: Automatic frequency monitors, automatic voltage regulators, cathode ray tubes, C.K. dosimeters, flying-spot microscope, incremental inductance bridge, industrial electronic metal detector, microsecond counter chronometer, mutual and self-inductance bridge, multi-channel recording equipment, phase correction units, photoelectric cells, portable metal detector, R.C. oscillator and automatic frequency monitor, square wave and pulse generator, visual valve tester, and wide range capacitance bridge. Nearly all these instruments are linked with demonstrations so that they may be seen under normal use conditions. Interested visitors are invited to bring samples for testing on the metal detection equipment so that it may be seen operating on their own products.

Costain-John Brown, Ltd., have exhibits by their instrumentation division illustrating their various services in the field of instrumentation and automatic process control. On the stand is an instrument cubicle made up from standardized panel sections. This contains instruments from most of the leading instrument manufacturers and is fully piped and wired to demonstrate various piping and wiring techniques. Among other exhibits is an example of graphic panel work.

A Working Model

The Crosby Valve & Engineering Co., Ltd., exhibit a working model of a displacement type level controller and valve showing the effect of variations of flow and level on the controller. Also shown is a sectioned displacement type air-operated level controller, a combined air-operated level controller and transmitter, and a sectioned diaphragm-operated globe type control valve. Particularly interesting is a sectioned working demonstration angle control valve and air-operated pressure controller; visitors can see the effect of varying the pressure being measured. Other exhibits include a partly-sectioned valve positioner in operation, examples of control valve bonnets available for various applications, a sectioned working demonstration sequential pressure switch, a range of self-actuated pressure regulators, a sectioned safety valve, various sectioned relief valves, a sectioned working demonstration bronze safety valve, and safety and relief valves.

Dawe Instruments, Ltd., exhibit equipment for both the industrial and the laboratory fields. In the former category come such instruments as ultrasonic thickness gauges, general purpose stroboscopes, 'slow motion' stroboscopes for resonance search tests, sound level meters, indicators and analysers, octave band analysers, acoustic calibrator and vibration measuring equipment. Instruments for the laboratory include audio frequency oscillators, valve voltmeters, pulse generators, impedance bridges, output power meters, microvolters and comparators, distortion factor meters, etc.

One of the instruments that can be of great assistance to the gas engineer is the ultrasonic thickness gauge. This is

Using the ultrasonic thickness gauge to measure the thickness of the wall of a cooling coil.

a fully portable piece of equipment and can be used for the measurement of the thickness of the walls of pipes, plating, tanks, retorts, gasholders, and any similar item, even if only one side is accessible. Until recently, such instruments suffered from the disadvantage that the minimum thickness that could be accurately measured in steel was 0.060 in. (there is a slight variation for other materials). The latest model, however, can be used on materials as thin as 0.02 in. This is not only useful on the lighter gauges of sheet metel, but also where heavy corrosion has occurred on plating that is nominally of heavier gauge.

Elcontrol have a handsome stand displaying examples of a wide range of industrial electronic controls, including process timers and cyclic timers, liquid level controls (including a working model showing a pump being controlled to give automatic filling of a tank), and a completely new range of photoswitches, light sources and separate viewing heads, indicating the adaptability of the Elcontrol design of units to a variety of industrial applications.

Flame failure or flame monitoring equipment, making use of the new infra-

red cells, are now becoming available. A demonstration gas burner set-up, complete with spark ignition, solenoid control valves and a fully automatic programming unit is on view. Proximity switches, including a new heavy duty unit, are also shown. Elcontrol are adopting a new type of construction for their standard units, in which the chassis is of the plug in type and readily removable without disturbing the external wiring. This and other improvements are clearly displayed.

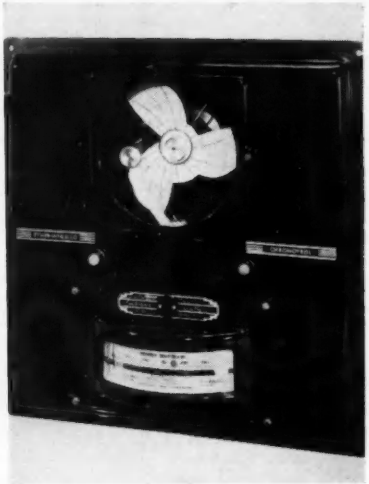
Electroflo Meters Co., Ltd., show a variety of indicating, integrating, recording and controlling flow meters for all fluids, and equipment for the measurement and/or control of pressures, temperatures, level, density and ratio of all fluids, etc. Automatic control of power and processing plants are shown, and other items include mechanical, electrical, pneumatic or electronic methods of measurement or control, remote, supervisory control and measurement, panels, cubicles and centralized control schemes, and graphic control panels.

Electro Methods, Ltd., have an exhibit showing a comprehensive range of components in the field of automatic temperature control together with new designs of standard types of relays and magnetic amplifiers. For the first time a complete range of American designed plugs, sockets and connectors are also displayed. Other exhibits include cartridge thermostats, overheat detectors, rate of rise controllers, contact thermometers, instrument relays, 1, 2 and 4 pole change-over, contactors, time delay relays, miniature polarized relays, magnetic amplifiers of high stability, magnetic amplifiers for educational purposes, saturable reactors, solenoids A.C. and D.C., solenoid operated valves, multi pin high grade connectors, plugs and sockets, printed circuit connectors, low inertia integrating motors, tacho generators.

Elliott Brothers (London), Ltd., show a comprehensive range of electrical measuring instruments (ammeters, voltmeters, wattmeters, etc). Process control equipment includes absolute pressure gauges, automatic control instruments for temperature, pressure, vacuum, draught, liquid level, flow, *p*H, humidity and mechanical operations, flowmeters, force balance transmitters, gas analysis equipment, humidity controllers and recorders, pneumatic transmission instruments, potentiometers, electronics for recording and for control, pyrometers, resistance thermometers, speed recorders, telemetering instruments, viscosity instruments for continuous indication, recording and control of viscosity. Other types of equipment covered include pressure regulators, diaphragm motor valves and level control equipment.

Ether, Ltd., are exhibiting their range of electrical and electronic instruments for the recording, controlling and indicating of temperature. These include the 'Ether-Wheelco' range of electronically-operated temperature controllers which are manufactured under licence from the Wheelco Division of Barber-Colman, Ltd., America. Included in this range are instruments giving on-off, multi-stage and fully proportional control, supplemented by the Capaciline and Xactline devices for anticipatory control.

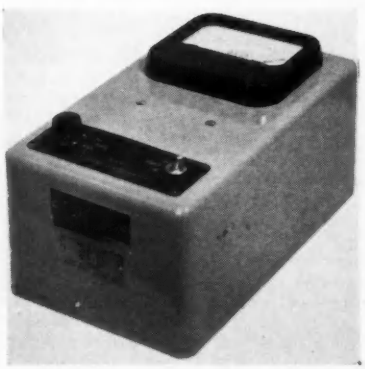
The Ether-Wheelco Chronotrol programme controller is also shown and this instrument is used where pre-determined heating and cooling cycles are called for. Also included is the Ether wide-strip electronic potentiometric



Electronically operated temperature controller fitted with combined programme unit enabling heat treatment to be carried out to predetermined time cycle.

recorder which is made to give up to six records. The exhibit is completed by a display of molten metal pyrometers, surface contact pyrometers, optical pyrometers, strip chart recording pyrometers, and the Ether-Wheelco combustion safeguard devices together with a comprehensive selection of solenoid valves.

Evans Electroselenium, Ltd., display a wide range of photo-electric equipment of both medical and industrial application. Recent developments in the latter field include the 'EEL' H_2S meter for accurately assessing the density of lead sulphide stains in gas purification, the



The 'EEL' H_2S meter.

'EEL' daylight factor meter, a small portable instrument to give readings of daylight factor in buildings, and the 'EEL' exposure controller to provide constant conditions of photographic exposure despite illumination fluctuations. Also on display are all the 'EEL' instruments, such as the portable colorimeter, flame photometer, absorptiometer, electrophoresis apparatus, nephelometer, reflectance spectrophotometer, universal densitometer, colour temperature meter, photometers and a wide range of mounted and unmounted selenium photoelectric cells.

Evershed and Vignoles, Ltd., feature a full range of instrumentation equipment including a console with an In-Line scanner for supervisory control. Process control equipment for the petroleum, chemical and allied industries is exhibited, together with equipment for combustion control in power plants and steel works, and telemetering and control in gas, water, drainage and electricity undertakings. Individual items include flow transmitters, for gas, steam and liquids, transmitters for temperature and pressure, level transmitters for pressure vessels, open reservoirs and oil storage tanks, a master steam pressure transmitter, electro-pneumatic, electro-hydraulic and all-electric valve positioners, a computer for 3-element boiler control, ratio control and steam/air control, and a meter for B.Th.U. measurement.

Fielden Electronics, Ltd., on a specially featured exhibit, introduce their patented system of plant process monitoring. Such variables as temperature, pressure, etc., are, by special transmitters, brought electrically to a small console. Here they are compared with pre-set values and, if they differ, alarm is given and printing mechanism records the time, point number and deviation value. The 'Tektor' and 'Telstor' level instruments are demonstrated, and also the recently announced 'Pyro-Servograph' temperature recorders together with D.C. and A.C. potentiometers, precision thermostats, etc.

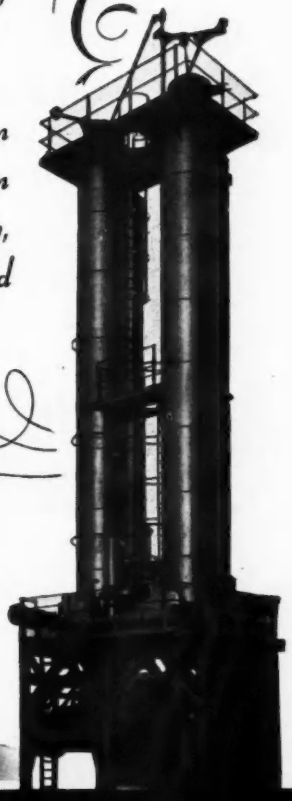
The Foster Instrument Co., Ltd., show a wide range of temperature measuring instruments including ferrous and non-ferrous foundry pyrometers, electrical resistance pyrometers, single- and multi-point temperature indicators, millivoltmeters and potentiometric type temperature recorders, automatic temperature controllers of both millivoltmeter and potentiometric types, and optical and radiation pyrometers.

Foxboro-Yoxall, Ltd., feature a display of Foxboro process control instruments covering temperature, pressure, vacuum, absolute pressure, flow, level, humidity, liquid density, conductivity, *p*H, capacity, speed, etc., in the form of indicators, recorders, controllers, transmitters and their related sensing elements, shown in different mountings, some in operation and others in section. These include the model 50 'Consotrol' series of compact recorder/controllers in a graphic panel presentation, the model 40 series of rectangular cased recorder/controllers, the d/p cell and the new 12A pneumatic temperature transmitter, Foxboro electronic dynalogs, with elements including the roll surface temperature head, 'Redox,' the 'Dewcel,' resistance bulbs, thermocouples and the new carbon electrode conductivity cells, and the 'Cyclelog' camless programme controller, speed control and pneumatic loading. A range of diaphragm and

1855

In 1855 Robert Dempster, a young Gas Engineer, founded at Elland a small Works for the production of all types of Gas Works Plant.

Today the business has grown into an organisation known throughout the entire Industry, playing its part in the field of technical advancement.



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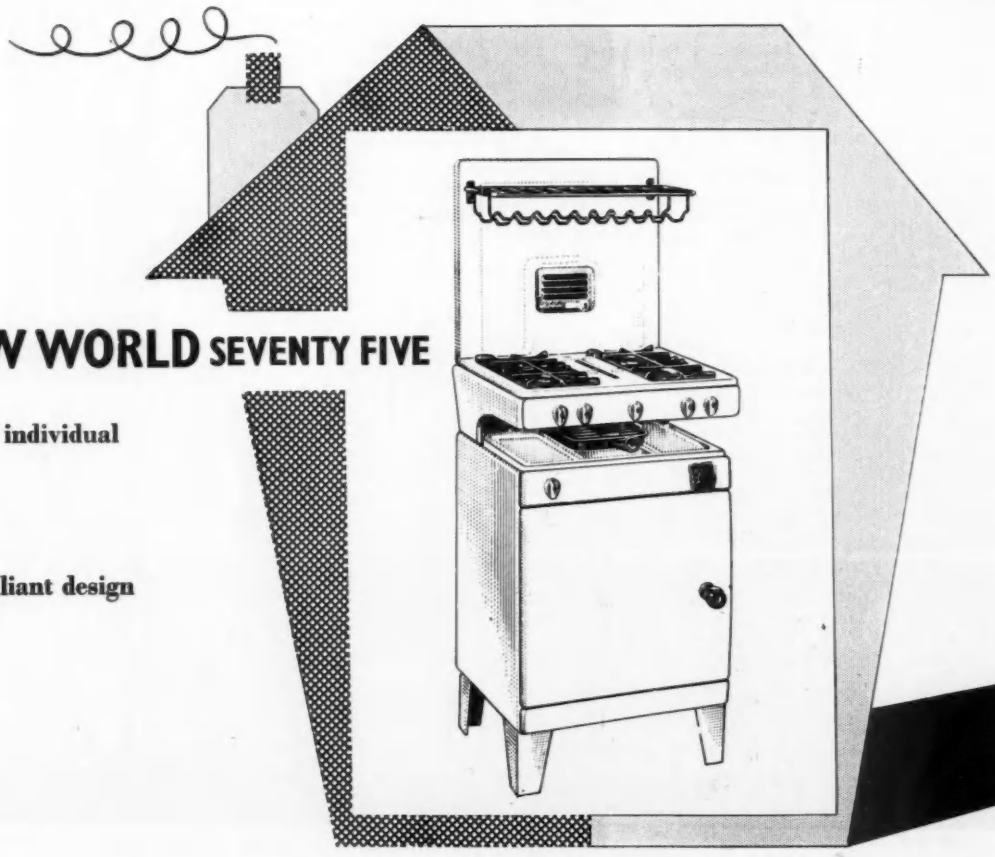

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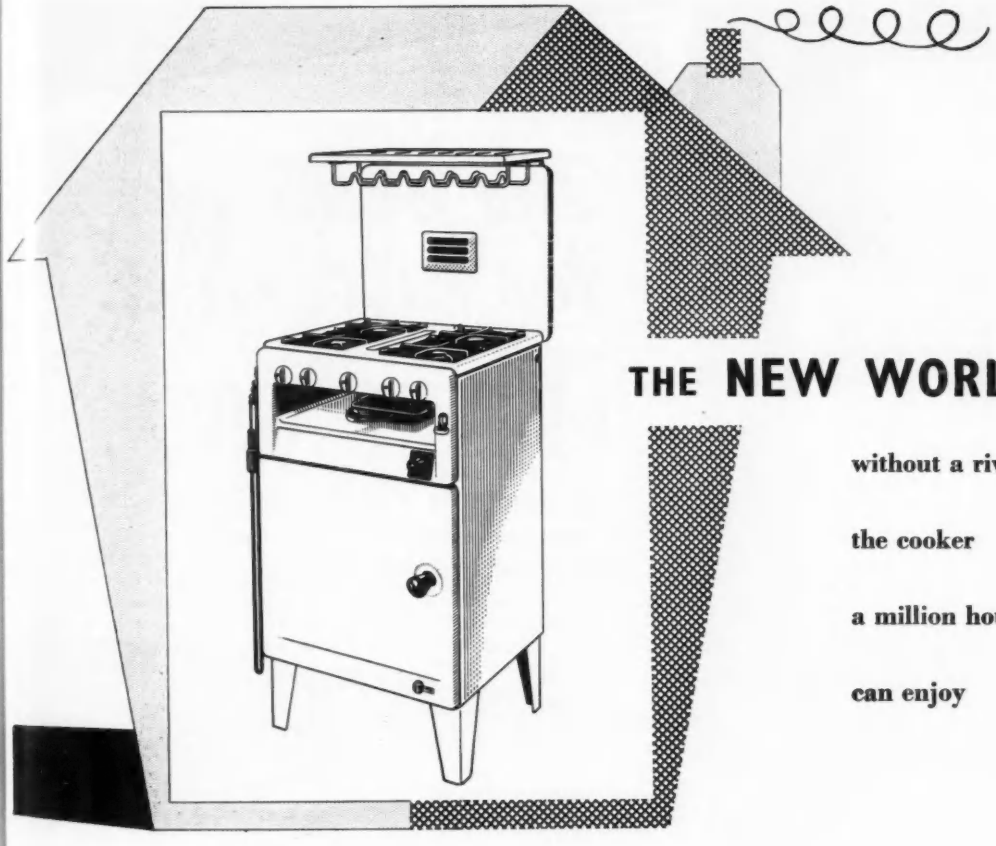

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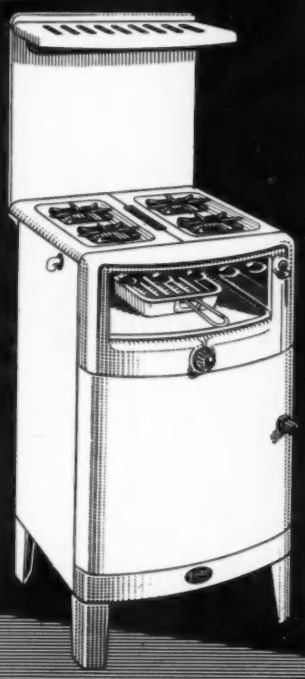

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THE

FLAVEL '68'

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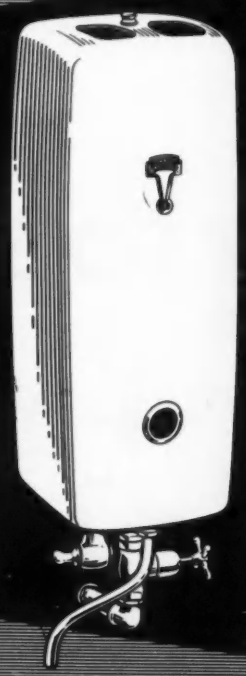

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cylinder-operated valves featuring the 'Stabilflo' series, the new low temperature valve, and examples of the type C valvactor and the new 'Poweractor' positioners are also shown.

The new Foxboro model 12A temperature transmitter.

The General Electric Co., Ltd., have as one of the main exhibits the electromagnetic transducer system which has been developed for the remote indication of pressures and mechanical displacements. The system is extremely simple in operation and is now being used in the atomic factories, on turbines, on oil supply lines, and in numerous other applications. A working model on the stand demonstrates its operation.

Other exhibits include portable and sub-standard instruments, panel mounting and switchboard instruments, a selection of special instruments, and a magnetic sorting bridge for the non-destructive testing of standard components. Power magnets are shown together with typical examples of instruments in which they have been incorporated. Precision potentiometers, instrument rectifiers and a range of electronic instrument components are also shown.

Honeywell-Brown, Ltd., on a large, handsome stand, show a range of apparatus so wide that we can only list it. In the field of instrumentation for research and development are a function plotter, a one-second recorder, and a multi-point precision indicator. Flow measurement and control are represented by differential converters, an area type meter, electronic inductance bridge receiver with electronic integrator, pneumatic controller, ratio controller, and a pneumatic receiver with electronic integration.

Also shown are such combustion safeguard systems as 'Protectoglo' relays and accessory equipment for flame-failure protection on gas or oil burners. Pyrometry accessories, thermocouple assemblies, a radiamatic pyrometer, a resistance bulb assembly, and extension lead wires are also shown. For heating, ventilating and air conditioning control systems, the company show non-indicating electronic modulating and two-position control panels, thermostats, motors, and motorized valves.

George Kent, Ltd., have two main themes as the basis of their display. One is the new 'Commander' class range of instruments. They feature flow level, specific gravity, pressure, temperature, transmission and automatic control. The other is the application of the Kent range of automatic controllers and measuring instruments to the efficient running of a variety of processes in individual industries. These applicational exhibits include the control of Wobbe Index of gas to glass working machinery, catalytic-cracker airflow and circulating water measurement, oil-blending under full automatic control, feeder level control for glass furnaces, glass-feeder temperature control, measurement and control of trade effluents, furnace temperature and combustion control in steel works, super-heat temperature control, standardized instrumentation for small boiler plants, and instrumentation for the control of a sulphur recovery plant.

The Leeds Meter Co., Ltd., show a representative selection of integrating meters and recording instruments for the measurement of water and industrial liquids. These include meters of several types ranging from the smallest size of Leeds rotary meter—¼ in. nominal diameter—to Helix meters up to 20 in. in diameter for the management of bulk water supplies. There are meters with several different types of dials and contacting system for industrial process applications. Boiler feed and water treatment metering is also dealt with in some detail. A number of the exhibits are cross-sectioned and examples of various component parts showing the workmanship and variety of materials in use are also on view.

Metropolitan-Vickers Electrical Co., Ltd., show several new instruments, notable among which is a vapour phase chromatograph for analyzing and separating gases and volatile liquids. The sample to be analyzed is injected into the top of a column which contains an inert packing such as Kieselguhr, impregnated with a high boiling point solvent. Nitrogen is passed continuously through the column, carrying the sample along with it as a vapour. The various components of the sample mixture pass through the column at different rates; the time taken to emerge is a characteristic of each component for a particular set of operating conditions. Vapour pressure and solubility in the stationary liquid phase, *i.e.*, boiling point solvent, affect the time of emergence of components so that the component which is least soluble and of highest vapour pressure emerges first.

The relative concentration of a component in the nitrogen stream is indicated by a thermal conductivity cell in the outlet line and a record is obtained by a pen recording instrument. This record is in the form of a series of peaks of conductivity plotted as a function of time.

Good separations can be obtained with many different types of compound, *e.g.*, hydrocarbons, alcohols, aldehydes and ketones. In order to carry out quantitative analysis, it is necessary to calibrate the instrument with the individual components or, for greater accuracy, with a synthetic blend. Qualitative analysis is assisted by the fact that, for a particular series of organic compounds, there is usually a simple relationship between the time of emergence and the chain length.

Other equipment shown by the company includes a range of portable precision instruments for power measurements, temperature indicators of various types, capacitor control relays for power factor improvement, house service pattern watt-hour meters, a selection of panel mounted electrical and measuring instruments with normal or circular scales, and miscellaneous industrial pattern measuring instruments.

Murex, Ltd., have an exhibit consisting primarily of sintered permanent magnets and pure tungsten, molybdenum, tantalum and zirconium. Recent developments in the field of sintered permanent magnets include the production of multipole annular magnets which are likely to have increasing application in the instrument field. Sincomax magnets of the smaller 'centre pole' type are are now in production and will offer a solution to many instrument design problems. The range of fabricated parts in pure tungsten, molybdenum, tantalum and zirconium has been extended considerably and these metals are finding many new outlets in industry. Expanded tantalum mesh will be available and may be of interest for corrosion-resistant purposes.

Mains Pressure Tester

Nash & Thompson, Ltd., show a mains pressure tester developed by the South Eastern Gas Board for leak-testing gas mains by the method of filling the mains with air under pressure and observing the pressure loss during a period of 24 hours or more. Until this instrument was produced there was considerable difficulty in measuring small changes in the comparatively high pressure of 50 lb. per sq. in. at which many mains should be tested. The mains pressure tester consists essentially of a dead weight gauge for balancing the high pressure, coupled to a liquid U-tube for measuring small pressure changes. One limb of the U-tube is connected to the main under pressure and the other to a cylinder fitted with a loaded piston (or ram). When the piston is floating, the hydrostatic pressure in lb. per sq. in. at the level of the piston end will be the weight of the piston (10 lb.) and the loading weights (in lb.) divided by the area of the piston (1 sq. in.) Under conditions of equilibrium the pressure at any one level in a fluid is constant and, therefore, the amount by which the air pressure in the main is less than the pressure exerted by the piston will be balanced by the pressure resulting from the weight of the fluid column above the piston end. The instrument is designed so that the datum disc is at the same level as the piston end and the scale is moveable so that the zero mark may be set level with the datum disc. A pressure gauge is provided so that the correct weights may be rapidly selected without trial-and-error loading.

In use the instrument is connected to the main under test, loaded with weights to produce a pressure just greater than that shown on the gauge, and the balance

read on the scale, the weight carrier being spun by hand to reduce friction between the ram and its bearing. The instrument is then disconnected from the main, and the measurement repeated 24 hours later. As all the readings are differences of pressure from atmospheric, and the information required is the absolute pressure inside the main, the barometer must be read in conjunction with the tester and allowance made for any change in atmospheric pressure. Other exhibits include an aeration test burner, and a number of other instruments, ranging from flow controlled switches to scintillation crystals.

Negretti & Zambra, Ltd., show industrial instruments for indicating, recording and controlling temperature, pressure, humidity, volume and flow, including mercury in steel indicating and recording thermometers, mercury in glass thermometers, electrical resistance and thermocouple type indicating and recording thermometers, and quick-reading potentiometers. Other exhibits include mercury in steel air-operated force balance type temperature transmitters, vacuum and pressure recorders, dial and edgewise type indicators, low-pressure amplifiers and transmitters, and electro-pneumatic converters.

The Rotameter Manufacturing Co., Ltd., show a selection of flowmeters which includes industrial and laboratory models for many gases and liquids. Typical applications are detailed with working exhibits, including direct indicating and transmitting instruments with recording, controlling and integrating receivers. The use of Rotameters in testing and analytical techniques is fully illustrated.

New developments shown include metric series rotameters, with interchangeable tubes and floats, full calibration information for liquids, and new mountings made by latest techniques with minimum number of fully standardized parts, and integrators, one of the 'chopping' type for use with direct indicating rotameters, and another providing continuous integration of transmitted air signal in 3-15 p.s.i. range. A fluid density meter suitable for slurries, is demonstrated. Also shown is the Ekstrom safety level indicator.

The Sigma Instrument Co., Ltd., in addition to a range of mechanical comparators and instruments for the gas industry, exhibits newly-developed instruments for automatic machine control. The 'Microtest' electronic surface finish comparator is demonstrated, and both a bench unit and semi-automatic machine incorporating Sigma 'Liquicolumn' indicator units are available for demonstration, together with a range of air measuring units and 'Dialair' indicators.

Stanton Instruments, Ltd., display a representative selection from their latest range of precision balances. This includes models suitable for use in universities and schools, as well as quick weighing analytical balances of varying sensitivities, and equipped with partial or fully automatic weight loading, and suitable for research and routine analytical work. Also on display are micro-chemical balances and a thermo-recording balance. The latter instrument provides a continuous record of weight changes of samples placed within the furnace, simultaneously with a record of the temperature within the furnace.

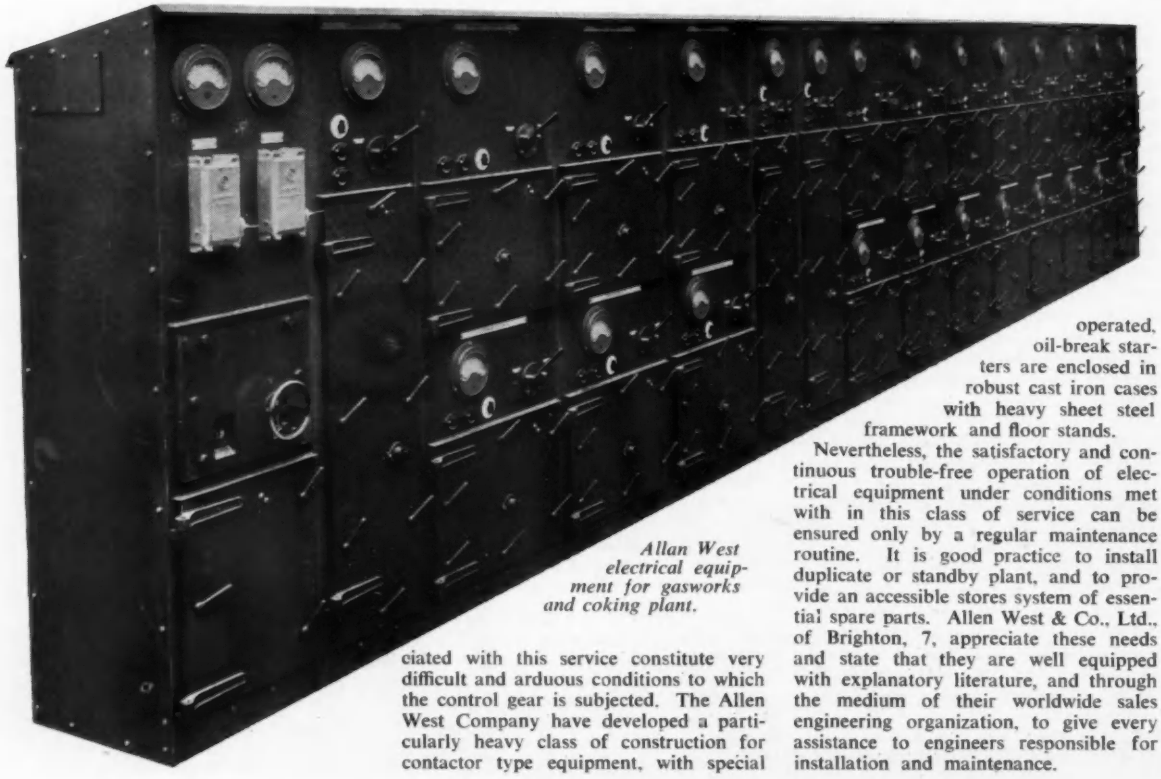
Sunvic Controls, Ltd., show the complete range of 'Nullmatic' industrial process control instruments, including working demonstrations: The exhibits

(*Concluded on p. 80*)

Electrical Equipment for Gasworks

Modern gasworks and coking plants rely on electrical equipment to a very large extent in order to maintain continuity of output. Allen West equipment, such as that shown in the accompany illustration, has been adapted to this specialized service. It is installed extensively at many gasworks and steelworks, not only for control of drives connected with the actual coal carbonization, but also for those related to the chemical and by-product plants.

The large unenclosed areas and the abnormal amount of grit and dust associated with this service constitute very difficult and arduous conditions to which the control gear is subjected. The Allen West Company have developed a particularly heavy class of construction for contactor type equipment, with special features to withstand dust, damp and chemical fumes to a high degree. Sheet steel not less than $\frac{3}{16}$ in. thick is used for enclosing cases; canopy top covers can be sloped to throw off heavy deposits of dust; and designation labels are vitreous enamelled. In other instances, hand operated, oil-break starters are enclosed in robust cast iron cases with heavy sheet steel framework and floor stands.



Allan West electrical equipment for gasworks and coking plant.

Nevertheless, the satisfactory and continuous trouble-free operation of electrical equipment under conditions met with in this class of service can be ensured only by a regular maintenance routine. It is good practice to install duplicate or standby plant, and to provide an accessible stores system of essential spare parts. Allen West & Co., Ltd., of Brighton, 7, appreciate these needs and state that they are well equipped with explanatory literature, and through the medium of their worldwide sales engineering organization, to give every assistance to engineers responsible for installation and maintenance.

Brookhirst Switchgear on Gasworks

Brookhirst Switchgear, Ltd., of Chester, have provided the photographs on this page. The picture across three columns is of a central control board at Denton gasworks, incorporating mimic diagram for the coal and coke handling plant. The left hand section is for coal and the right hand section for coke handling. Operating in conjunction with four switchboards, the board provides visual indication of motors running and positions of chute switches in addition to starting and stopping control of motors.

The drives include conveyors, feeders, magnetic pulleys, screens and samplers and there are a total of 68 drives, controlled in sequence by the switchboards. Alternative routes are selected by two-position chutes and the 37-chute switches fitted to these provide the electrical interlocks which prevent incorrect operation.

All starters may be (1) run in sequence; (2) run out of sequence—*i.e.*, motor test; or (3) operated without running the motors—*i.e.*, controls test. Features (1) and (2) are obtained by means of a selector switch on each starter having in addition to an 'off' position, positions 'sequence' and 'motor test' and this switch is always master. In the 'sequence' position control may be in sequence from the push-buttons on the mimic diagram of the central control board or from the push-buttons mounted near the motor, depending upon the position of a further selector switch on the central control board. In the 'motor test' position, starting is possible only from the push-buttons near the motors which may start out of sequence.

Testing of the starter without running the motor is carried out by means of a test position on the isolator. Any desired operation of the plant, in sequence if required, can be tested without the motors running by observing the lights on the mimic diagram.

An alarm system is installed so that before starting up a sequence from the central control board, the operator is obliged to press a 'start alarm' button. The audible alarms sound for a time interval, which is adjustable and then a 'ready to start' lamp is illuminated. The alarm can then be cancelled and the sequence started. When control is local to the motors, the alarms need not be sounded.

The functions of the conveyor system are:—

(1) Passing incoming coal to the bunkers and/or to the coal stockyard.

(2) Reclaiming coal from the stockyard and passing it to the bunkers.

(3) Passing coke from the retorts to the coke storage hoppers (via screens) and/or to the coke stockyards.

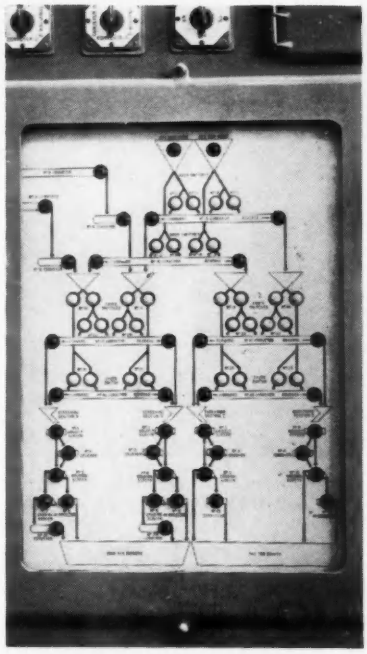
(4) Passing coke from the storage hoppers to the producers and/or to the retort feed hoppers.

(5) Reclaiming coke from the coke stockyard and passing it to the coke storage hoppers (via screens).

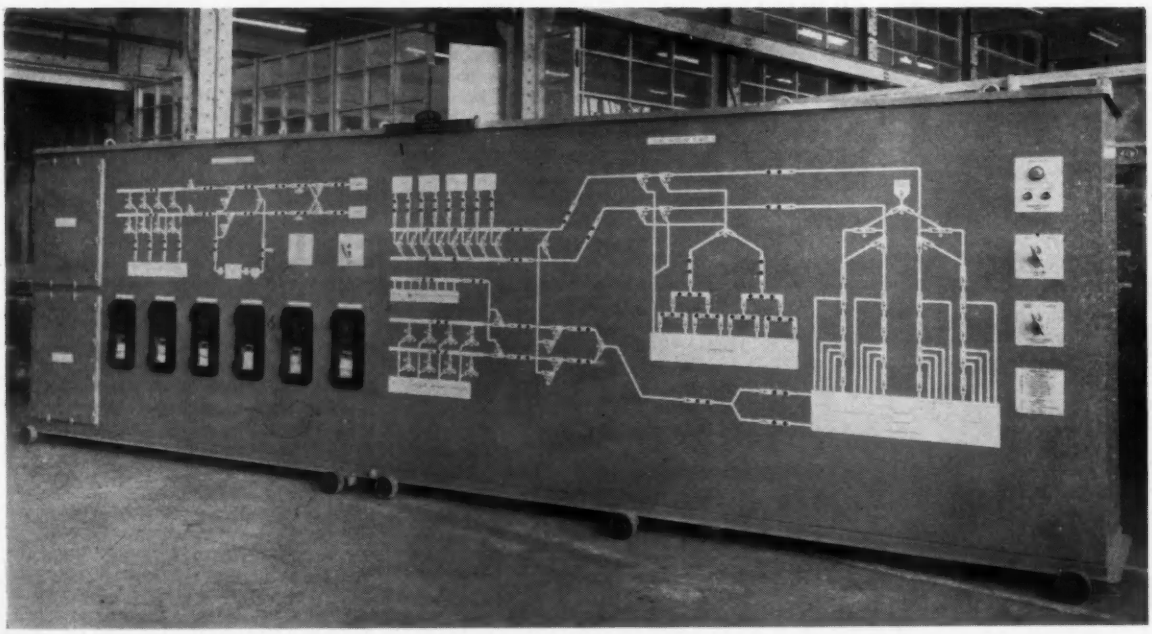
(6) Passing coke which is larger than 2 in. from the coke storage hoppers to the stockyard.

Garston Gasworks

The smaller photograph shows a type 950 'Majorbord' switchboard for controlling the coke screening plant at Garston gasworks. A special mimic diagram with fluorescent indicating lamps protected by armour plate glass is built into the centre of the board. The drives comprise six 3 H.P. reversing conveyors; six 6 H.P. non-reversing conveyors; two 17½ H.P. non-reversing conveyors; two 10 H.P. non-reversing conveyors; four 5 H.P. grizzly screens; two 6 H.P. grading screens; four 2 H.P. debreezers; one 300 A main incoming switch fuse; and two 60 A switch fuses for feeders to skip hoists.



Type 950 'Majorbord.'



Central control board at Denton gasworks, incorporating mimic diagram for coal and coke handling plant.

Progress of C. & W. WALKER LTD. . . . A Record of 118 Years Service

The Company's fine record would have been impossible without the loyalty and devotion of its staff and employees, many of whom have the distinction of 40 years or more of unbroken service. This photograph of men with long service records, taken a year ago, is reproduced from the commemorative brochure.

The firm of C. & W. Walker, Ltd., is now in its 56th year as a limited company, and has completed 118 years as engineering contractors. This long record of service, which has been devoted principally to the gas, chemical, and oil industries, is suitably placed on record in the form of a historical survey, published in a handsome brochure, for the benefit of customers and others interested in the Company's progress.

The Company was one of 22 centenarian firms whose histories were briefly reviewed in our own Centenary Number early in 1949. It began in 1837 in a small establishment at Little Sutton Street, Goswell Street, Clerkenwell, under the direction of Mr. Charles Walker, who had three sons, Matthew, Charles Clement, and William Thomas. The two younger sons, Charles Clement and William Thomas, were associated with their father in the business at Clerkenwell. In 1857 the works was transferred to Donnington, near Wellington, Shropshire, when the father handed over the control of the undertaking to his sons, the firm then becoming known as C. & W. Walker. Charles supervised the works, and William devoted most of his time to looking after the firm's interests in London, where an office was opened in Finsbury Circus. Later William also developed and managed the firm's business on the Continent and abroad.

About 1882 Friedrich Weck, a nephew of Mrs. Charles Clement Walker, joined the firm and introduced the famous Weck valve for controlling the flow of gas to purifiers; his activities were cut short by his death about 1890 while on a voyage between Australia and New Zealand.

The works at Donnington was first centred in a small blacksmith's shop in which repairs to farm implements and the shoeing of horses had previously been carried out. In the early days of the firm at Donnington the operations were largely of a general engineering character. Only 30 or 40 workmen were employed, and the curtilage of the works embraced only two or three acres of ground. The first order entered at Donnington was for a brewer's still, but a pencil note, evidently added at a later date, suggests that the still was required for tar distillation. Whatever the true purpose, it is clear from records that the firm was well established as builders of gasholders long before the business was transferred from Clerkenwell to Donnington.

It was during the building of the Beckton Gasworks by the Chartered Gas Company (now incorporated in the North Thames Gas Board) in 1868, that the firm came into prominence as builders of large gasholders and purifiers. From that time C. & W. Walker's business developed rapidly, and during the next 24 years more land was rented, machine shops were extended, and larger numbers of workers were employed. On the death of William Walker in 1892, Charles Walker carried on the business alone for some years. After his death the undertaking was formed into a limited company in 1899, with an authorized capital of £100,000. At a later date the capital was increased to £150,000, and in 1954 was further increased to £300,000, of which £183,947 has been issued. The capital of the undertaking is small in relation to its size, due to the kindness of the executors of the estate of Charles Clement Walker, who expressed a desire that the Company should be floated at a comparatively low figure.

The Midland Iron Works at Donnington covers nearly 18 acres of ground and employment is found for some hundreds of workpeople. The works comprises a well equipped steel department, pattern shop, foundry, fitting shop, machine shop, planing yard, saw mill and general stores, together with a large erecting yard, an iron and steel stock yard, a timber yard and tackle stores. A modern system provides electric power for driving the machines in all the shops.

Up to 1914 the machines were driven by large horizontal steam engines connected to overhead countershafts and the steam raising plant consisted of six Lancashire boilers arranged for manual firing. The change over to water-tube boilers with mechanical stoking and electrically driven machines in all the shops was a major operation in its day, but this was organized and carried out with such care that no loss of production resulted. In 1926 further additions were made to the steam raising plant and also to the electrical generators.

A decision was made in 1938 to connect up to the West Midlands Joint Elec-

tricity Authority, and electrical mercury arc rectifiers were installed, together with transformer units. This plant was so arranged that electric current could be taken from the West Midlands Grid or, alternatively, generated in the works. The advantages were soon apparent after the war broke out in 1939, and the Company was able to use its own power supply during the electricity cuts, which the West Midlands Joint Electricity Authority found necessary to impose during the winter months. For some years after the war electricity cuts were made on account of the shortage of plant, and until recently the steam electrical generators have been working one or two days a week during the winter in order to augment the supply of electric current from the West Midlands Grid.

To meet the requirements of the Company's increasing business activities, it became necessary to move the London office from Finsbury Circus to 110, Cannon Street, and in 1926 a further move was made to 70, Victoria Street. During the last war this office was temporarily closed, but was re-opened in 1946.

Progress in Gasholder Construction

One of the Company's greatest achievements was in 1913, when it undertook the design, manufacture, and erection of the largest guide-framed gasholder ever to be made in this country. This was to the order of the Australian Gas Light Company for Sydney, N.S.W., and has a working capacity of 12,500,000 cu.ft. The design was supervised by the late R. J. Milbourne, and is referred to in his book on 'Gasholder Design and Construction,' published in 1923. The Company was also early in the field with the design and manufacture of the spirally-guided gasholder. In 1926, C. & W. Walker, Ltd., designed and constructed the largest spirally-guided holder in a steel tank to be erected in this country at that time. The capacity is 5 mill. cu.ft. and the contract was for the Bournemouth Gas and Water Company. This gasholder had only just been completed when a further contract was placed with C. & W. Walker, Ltd., for a holder of similar capacity for the Reading Gas Company. Much research work has been carried out during the last 20 or 25 years on spirally-guided gasholder design, and Mr. S. M. Milbourne has added to the literature on this subject by his treaties on 'Stresses in Spirally-guided Gasholders,' published in 1937, and papers which he has contributed to the Institution of Gas Engineers.

In 1892 the firm erected the largest guide-framed gasholder at Beckton, having a capacity of 8 mill. cu.ft. This holder had been in almost continuous service from the time it was built until it was seriously damaged by bombs during the second world war. C. & W. Walker, Ltd., have secured contracts for the reconstruction of this holder and also for the replacement of another large holder destroyed by enemy action. The Company has also played its part in the development of high pressure gasholders, which have been found to be most satisfactory in certain instances, especially in connection with the distribution of gas in outlying districts. From 1868 the design and manufacture of condensing, washing and purifying plant, together with the construction and erection of large gasholders, became the principal business of the firm.

The Walker Purifying Machine

Patents were taken out by the partners, Charles and William Walker, for improvements in condensing, washing, scrubbing and purifying plant, including the notable 'Walker' purifying machine. Since those days many changes have been made in the design of such plant. The purifying machine has given place to the 'Walker' static washer. In 1939 the Company made and erected one of the largest installations of its kind for ammonia extraction, for the Dundee Corporation Gas Department. This consists of two units, each capable of dealing with 10 mill. cu.ft. of crude gas per day.

Reference should be made to the important part played by C. & W. Walker, Ltd., during the first and second world wars. From 1914 to 1918 the Company was engaged on the fabrication of steel plates for standard ships, also the manufacture of nickel steel pressings for field gun carriages and armoured tanks. A large number of cast iron nitre pots for the preparation of high explosives were also made in the Company's foundry, and these were fitted up completely with lead lining and mechanical agitating gear. From 1940 to 1945 C. & W. Walker, Ltd., undertook the fabrication of many thousands of tons of steel plate and bar work for standard ships, and in addition manufactured sections of welded steel tugs, mine destruction gear, bomb casings and a great variety of other work, including parts of the famous Bailey bridges, which were so largely used by H.M. Forces following the D-Day landings. During the Battle of Britain, when the invasion of England was threatened, the Company collaborated with the Ministry of Supply in the design of heavy steel shields for the large calibre guns of the coastal defences. These shields were made at Donnington and erected at the respective sites, sometimes under hazardous conditions during enemy air raids. Other work undertaken was the repair and reinstatement of bomb-damaged gasworks plant.

Cordial relationships exist between the management, the staff, and the workpeople. To attain this end the Company has always striven, and many employees have put in long terms of service. Such continuity in industry makes for the highest efficiency, and contributes to the wealth of experience which is of inestimable value to any engineering undertaking.

EIGHTY-NINE NOT OUT

A record of nearly three-quarters of a century of service to the gas industry was completed last month with the retirement of Mr. C. H. Buck from the staff of Thomas Glover & Co., Ltd. Mr. Buck, who is nearly 89, entered the industry as an indentured apprentice with Parkinson & Cowan, and joined Thomas Glover & Co., Ltd., in 1894 at the age of 27. With the exception of a brief period in the machine shop during the first world war, he has spent the whole of his 61 years with the Company in the automatic proving department. He has watched the firm grow from four relatively small factories in the Clerkenwell area to its present vast size at Gothic Works, Edmonton, where he has been employed ever since this factory was opened in 1899.

To mark his retirement and as a token of esteem, the Board of Directors of Thomas Glover & Co., Ltd., presented Mr. Buck with a cheque. The presentation, which was made by Mr. D. Sime, Deputy Managing Director, was attended by Mr. Buck's friends and colleagues in the factory, 14 of whom have themselves competed over 50 years continuous service with the Company.

Mr. C. H. Buck (seated, centre) who has just retired after completing 61 years continuous service with Thomas Glover & Co., Ltd., with 14 of his colleagues at Gothic Works, Edmonton, all of whom have themselves completed over 50 years service.

NORTHERN JUNIORS' SEVENTH ANNUAL MEETING

The seventh annual general meeting of the Northern Junior Gas Association was held at the Kings Head Hotel, Barnard Castle, on June 17, when the President, Mr. C. Hindle (Darlington), gave his Presidential Address. Opening the business session Mr. Hindle expressed his pleasure at the extremely good attendance and welcomed Mr. J. E. White, Deputy Chairman of the Northern Gas Board, Mr. J. R. Bradshaw, part-time member of the Northern Gas Board and formerly Deputy Chairman, and Mr. W. Sutcliffe, Chairman of the North of England Section of the Institution of Gas Engineers.

Mr. G. E. Haddon, Hon. Treasurer, presented his statement of accounts and in referring to his resignation appealed to the members to make the new Treasurer's job easier by a speedy payment of subscriptions and accounts for *Transactions*. He referred to the generally satisfactory state of the Association's accounts and the lowness of the subscription.

Cost of Transactions

Mr. P. N. Lee, Transactions Secretary, explained that the 1951-52 *Transactions* were being distributed and the 1952-53 *Transactions* were in the hands of the printers. He also referred to the endeavours of the Council to keep the price as low as possible and said a further reduction was possible.

Mr. C. Hindle then delivered his address, to which we hope to refer in a later issue of the 'JOURNAL'.

A vote of thanks to the President was proposed by Mr. L. Nelson (Blyth) who said that the address would have produced a most interesting discussion had this been possible. He referred to the beneficial effect of increased coke sales in assisting in the reduction of air pollution, particularly in Darlington, and also to the problems of importing coke into works which were producing it before integration.

Election of Officers

The following officers were elected for the ensuing session: President: P. N. Lee (Middlesbrough), Senior Vice-President: J. C. Graham (Newcastle), Junior Vice-President: A. S. Tait (Bishop Auckland), Hon. Secretary: R. Aynsley (Newcastle), Hon. Treasurer: C. H. Ling (Darlington), Hon. Transactions Secretary and Publicity Secretary: R. S. Longhurst (Carlisle), Hon. Auditors: A. O. Old (West Hartlepool) and D. Yule (South Shields), Member of Council: H. W. Waiton (Howdon-on-Tyne), Northern District Education Committee: C. Hindle (Darlington), G. E. Haddon (Stockton-on-Tees), and P. N. Lee (Middlesbrough).

Mr. W. Sutcliffe, Newcastle, Chairman of the North of England Section (Institution of Gas Engineers) and Mr. K. E. Brown, Newcastle, Hon. Secretary, were elected to Honorary Membership of the Association.

Mr. P. N. Lee, the new President, then proposed the election of Mr. J. R. Bradshaw as Honorary Life Member of the Association. Mr. Lee referred to the many distinguished services rendered to the gas industry by Mr. Bradshaw and to his high repute in the gas industry nationally. Only two other Life Members of the Association had been elected, these being Mr. E. Crowther, the present Chairman of the Northern Gas Board, and the late Mr. Arthur Clement Hovey, who was well known for his generosity to the Association. The President wished Mr. Bradshaw continued good health and long life and the proposal was carried with acclamation.

Mr. Bradshaw, in acknowledging the honour, referred to the fact that Mr. Lee had started his career in the gas industry under his management. He had since followed his progress with interest, and wished him continued success.

The President presented to Mr. C. H. Ling (Darlington) the Silver Medal of the Society of British Gas Industries for his paper 'Gas at Newton Aycliffe".

Mr. C. Hindle, the retiring President, received a certificate from his successor, Mr. Lee, who referred to the smoothness and efficiency with which Mr. Hindle had presided over the affairs of the Association and hoped that the certificate would remind him of a happy year of office.

A vote of thanks to the officers was proposed by Mr. J. McManus (Blyth) who paid tribute to the good work of the retiring Treasurer and wished all the officers, including the new Treasurer and the Transactions Secretary, every success in their work. Mr. Aynsley (Secretary) acknowledged the vote of thanks and spoke of the growing membership of the Association and the continued progress it was making.

The meeting adjourned for lunch where Mr. F. Wilson, Divisional General Manager, Darlington Division, extended a hearty welcome to the Association.

Mr. Hindle proposed a toast to the guests, who had been joined by Mr. F. W. Anderson, General Manager of Glaxo Laboratories, Ltd. Mr. J. E. White, replying on behalf of the guests, referred to the wide opportunities available to the younger men in the industry.

After lunch the Association paid a visit to the laboratories and works of Glaxo Laboratories, Ltd., where they were shown the clinical conditions under which streptomycin and allied products were packaged at the works and the rigorous chemical, bacteriological, and biological testing which the products received.

Tea was taken at the Kings Head Hotel, where Mr. R. S. Longhurst (Carlisle) proposed a vote of thanks to the Northern Gas Board for the hospitality the Association had received.

PLYMOUTH'S NEW TAR WORKS

We reported last week the inauguration of the new tar works of Plymouth Tar Distilleries, Ltd., at Cattedown, Plymouth, and gave a brief description of the very modern plant installed there.

Control is almost entirely automatic. To provide for this, the instrumentation is of a high order, to which the control room with its numerous level, flow, temperature, and pressure indicators and recorders bears witness. The base tar flows from the distillation plant to two mixing vessels of 15,000 gal. capacity, where blending with creosotes of definite boiling ranges takes place. The mixing equipment in these vessels is of the side entry propellor type supplied by Premier Colloid Mills, Ltd. A further horizontal cylindrical blending vessel with overhead mixing gear of the same pattern is used for the preparation of special or proprietary road binders. Following the blending process which gives road tars of the desired viscosity and specification, the products are delivered by electrically-driven 'Drum' rotary pumps to two storage tanks of 130,000 gal. capacity or to two rows of overhead service tanks. The latter provide storage for all grades and from them road tars of suitable temperature are loaded by gravity into spraying vehicles, tankers, or drums. A feature of the plant is the extent to which insulation has been employed for all vessels of which the contents are at elevated temperatures. Thermal efficiency and the need to restrict the use of fuel have been kept well to the forefront.

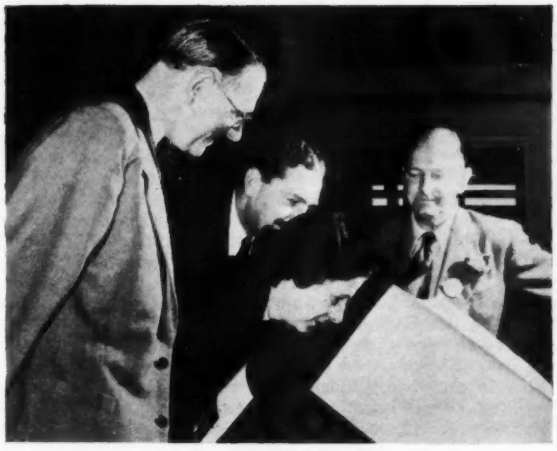
The mixing vessels are used for the oiling back of the base tar with special creosotes to provide coal tar fuels, used in the West Country for a number of purposes including steam raising, china clay drying, etc. The oils produced at the distillation plant are delivered by electrically-driven centrifugal pumps to storage tanks from which some are blended to provide creosote to various specifications for use in timber preservation. Others are subjected to further distillation or extraction processes to yield products of great value to the chemical industry. These include motor benzole, toluole, pyridine, phenol, cresol and naphthalene.

Because the new site is separated from the old site by rail tracks, there has been employed a reinforced concrete pipe bridge 75 ft. in length. This work was carried out by James Miller & Partners, Ltd., who were also responsible for other work in the first development section.

London and Southern Juniors Ladies' Day Visit to Watson House

As reported in last week's issue of the 'JOURNAL,' the London and Southern Junior Gas Association's summer visit and Ladies' Day this year included a tour of the Watson House laboratories of the Gas Council. This week we present some informal groups photographed during the visit. The tour took place in not only the well-established hot water, space heating, cooker and engineering laboratories, but also the new block which includes the coke, industrial, large equipment and aerodynamics laboratories. Although, quite naturally, the ladies were particularly interested in the cooker laboratory and its kitchen, there was, nevertheless, plenty of evidence that they found work in progress in the hot water and space heating laboratories most fascinating. The demonstrations of the inner workings of washing machines and refrigerators were obviously 'right up their street.' There was also quite a continual trek into the 'hot room' where refrigerators are tested under the most rigorous conditions they are likely to meet. In the new coke laboratories a number of improved coke burning grates were shown in operation and there were also some modern coke fired boilers on view.

The members of the Association and their ladies were the guests at Watson House of the North Thames Gas Board and the Board was well represented on this occasion by its Chairman, Mr. Michael Milne-Watson, C.B.E., and Dr. J. Burns, G.M., the Chief Engineer, both of whom seemed to enjoy the tour of the laboratories as well as anyone else. Altogether it was a memorable day, one on which Mr. E. W. B. Dunning, the retiring President of the Association, can look back with pride.



Mrs. Milne-Watson looks at colour transparencies of coke fires alight.

Above. Top table at luncheon: (from camera), Mr. N. R. Junkison, Mrs. E. W. B. Dunning, Mr. Michael Milne-Watson, Mr. E. W. B. Dunning, Mrs. Milne-Watson, Mr. L. W. Andrew. Above right: Dr. J. Burns, Mr. Michael Milne-Watson, Mr. E. W. B. Dunning, Mrs. J. Burns, Mrs. Milne-Watson and Mr. Hinshelwood in the industrial laboratory.

Above: In the cooker laboratory, Mr. Bradley demonstrates an experimental removable oven lining.

Right: Mr. Newman of the coke laboratory describing free standing convector fires to a group of ladies.

Advice on Smokeless Zone

The Corporation of London is setting up a Smokeless Zone Advisory Centre to provide the opportunity for citizens and business houses to learn more about the forthcoming legislation making the city a smokeless zone. The centre will be open from July 11 to 22, between 11 a.m. and 6 p.m. Mondays-Fridays. It will be near the City of London Information Centre in Cannon Street. Pamphlets, information, and free advice will be available, and there will also be on show various fitments.

Besides the Corporation of London, others associated with the centre will be the National Smoke Abatement Society, the Solid Smokeless Fuels Federation, the North Thames Gas Board, the London Electricity Board, the Coal Utilization Council, the Combustion Engineering Association, and the British Oil Burner Manufacturers' Association.

Dutch Cookery at Paisley

The Paisley District of the Scottish Gas Board co-operated with the Netherlands Dairy Bureau in holding a 'Dutch Dairy Week' at Paisley last month. Daily cookery demonstrations in the showrooms by Miss Joyce Forlow, Home Service Adviser, included a number of Dutch cheese dishes.

At a special evening demonstration, Miss E. Bragge (Cookery Adviser to the Bureau) demonstrated various cheese dishes to a capacity audience, to which an invitation had been extended to teachers of domestic subjects in Renfrewshire schools. The evening concluded with the showing of a film 'Land of Milk.' During the week, great interest was shown in a showroom window display designed to attract attention to the cookery demonstrations by displaying the various cheeses in their colourful wrappings. A decorated float depicting a Dutch garden scene also toured the town, and on a permanent site a caravan displayed the dairy products, this being staffed by girls in Dutch national costumes.

Royal Highland Show

The gas industry played a useful part in making this year's Royal Highland Show effective and successful. The Gas Council had its excellent stand as in previous years, with major emphasis on domestic applications but with attention to space heating, water heating, coke and industrial applications.

The Edinburgh District of the Scottish Gas Board laid on a main from the Corstorphine road to serve the major catering units on the showground. Starting on the Thursday previous to the show the main was completed and in use by the Sunday before opening. In addition to this use of town gas, the show made extensive use of bottled gas for catering, heating and other uses. Two of the major concerns in this field also had outstanding shows.

'Rural Gas in an Ezee Kitchen' was the theme of the show of Scottish Rural Gas, Ltd., which concentrated on demonstrations of cookery. In addition Scottish Rural Gas staged a display of modern appliances in the domestic and industrial sphere. Calor Gas (Scotland), Ltd., has been prominent at many of the major Scottish shows and used here its full display space made up of double the unit which it uses at smaller events. There was a caravan section, a domestic section, a farm section, and a service section, each showing the scope and application of Calor Gas in these spheres. Among the newer equipment on show there was the new B500 Minor caravan cooker, with one burner, one grill and griddle, a compact and efficient model for use in limited space; and the new Main 109 four-ring, grill and roomy oven model.

Belfast Corporation at its meeting on July 1 decided to increase gas charges for ordinary consumers by 6½d. per 1,000 cu.ft. The Council was acting on the recommendation of the Gas Manager (Mr. J. L. Hyslop), who reported that the increase would yield only £82,000 during the current financial year. Prepayment consumers' charges are also increased by approximately the same amount. In his report Mr. Hyslop said the estimated increased revenue from the new charges would be insufficient to meet the increased expenditure to which they were committed. He anticipated, however, that it would be sufficient eventually to stabilize their position financially in respect of costs now existing. But it would be appreciated that for the current year a deficit might be expected.

Loughborough Closes Down

Gas ceased to be produced for the first time in 120 years at Loughborough gasworks at 6 a.m. on June 24. Once Loughborough gasworks was described as the most modern in this country.

The change marked another step in the East Midlands Gas Board's policy of supplies by the grid system. For some time Loughborough has been drawing supplies from outside sources. Eventually the town supply will come from the National Coal Board's centralized coke ovens at Chesterfield.

Mr. S. J. Horrod, Loughborough Group Manager, who supervized the shut-down, said consumers could rest assured that the service they would receive in future would be as good as in the past. Indeed, now the local staff was no longer concerned with the actual manufacture of gas it would be able to concentrate more fully on service, maintenance, and sales production had always before been the keynote of operations there, but in future 95% of the undertaking's function would be sales and service.

Mr. W. R. Armstrong, Gas Manager, in a report to Coleraine Borough Council, stated that from April 27 to June 1 the amount of gas manufactured was 17,199,100 cu.ft., an increase of 2,296,600 cu.ft. over the corresponding period last year. An increase in freight charges would cost the Gas Department £360 per annum. Due to the same cause the price of coal would also be increased and a further £650 per annum would have to be met by the Department. Mr. Armstrong described existing coal stocks as 'very healthy.'

BRITISH INSTRUMENT EXHIBITION—*From p. 74.*

include several new instruments, notably a 'plug-in' controller and M/P station, a new miniature pressure regulator, and improved valve positioner and additions to the pressure transmitter range. A leak detector—a production tool of particular interest to those concerned in the detection of minute leaks in castings, etc., in large scale production is another interesting exhibit. The range is completed by such instruments as electronic recorders, D.C. amplifiers, resistance thermometer controllers, thermostats, relays, time delays, etc.

The Thermal Syndicate, Ltd., show many types of laboratory ware, tubing and rod in vitreosil pure fused quartz and silica. These are unaffected by acids, except hydroflouric and phosphoric. Special high temperature refractory ware in mullite, alumina, magnesia, zircon, zirconia, spinel and thoria, covering temperature ranges to 2,200°C., is also shown.

Walker, Crosweller & Co., Ltd., show for the first time the Arkon method of telerecording—*i.e.*, the electrical transmission of readings to a distance. This patented system transmits and reading—for example, rate of flow—over any distance and provides the usual three forms of presentation—*i.e.*, chart reading, continuous indication and integration. It is a flexible system, particularly well adapted to the needs of the gas industry, and allows several independent readings to be transmitted over one pair of wires. A typical application is the transmission of rate of flow, gas pressure and holder height from an unattended station to a control room; the same wires can operate remote controls in the reverse direction. When the receiving instrument is a chart recorder, it embodies a special feature of the Arkon Series 1600 recorder, namely horizontal chart movement, automatic chart pick-up and evenly divided charts with rectangular co-ordinates.

Also shown is the full range of Arkon model 1601 gas and air flow recorders, and model 1600 pressure and vacuum recorders for direct or local recording. One of these instruments is working as a water flow recorder operating from a V-notch, using the principle introduced by the makers 20 years ago. The exhibit also includes a representation selection of water column gauges and flow indicators.

BIRMINGHAM SAFETY AND EFFICIENCY EXHIBITION

In modern factories the prevention of accidents which, apart from injury to workers, cause loss of production, attracts increasing attention on the part of manufacturers. With gas used to an increasing extent in industry the provision of safety devices for equipment is of paramount importance. Varied examples of products designed to this end were illustrated in the third Birmingham Industrial Safety and Efficiency exhibition opened in the City's Bingley Hall on June 24 and continued until July 1.

The exhibition had a widespread interest for Birmingham because the West Midlands area is the largest user of gas for industrial purposes in the country and returns this year show that this use by industry is on an increasing scale. It is a notable fact that of the total sales of gas by the West Midlands Board nearly 50% are for industry.

The West Midlands Gas Board stand showed a full range of electronic, thermo-electric, and other protective devices available for use with gas-fired plant in industry. The electronic equipment displayed included a special demonstration panel constructed by the North Thames Gas Board, incorporating electronic flame failure equipment by Elcontrol, Ltd., which provides for a purge period by electrical timer to ventilate ovens before lighting of the burners commences, automatic ignition, and includes protection against air supply failure. The sequence of events is indicated by signal lights so that the operation of the unit can be easily conveyed to interested parties. Automatic electronic flame failure equipment, by Ether, Ltd., and Honeywell Brown, Ltd., was also displayed.

A full range of thermo-electric devices, by Perl Controls, Ltd., Sperryn & Co., Ltd., the Rheostatic Co., Ltd., included the Perl Junopilot for multi-burner control, and the Sperryn G.809 counterpart. Sectionalized thermo-electric valves were displayed for the benefit of visitors interested in the working principles.

Associated equipment included air pressure switches and valves, relay valves, manually-re-set cut off valves, ladder bridging pilots, gas governors, and a range of industrial thermostats by the makers referred to and De la Rue & Co., Ltd. Many of these items were sectionalized to show the working parts.

A notable result of the efforts made to promote industrial safety and efficiency is the fact that workers in Birmingham factories today are more safe from accidents than at any previous time. It is computed that in industry generally accidents have been diminished by as much as 25% within less than a decade. This has been largely brought about by the adoption of an enlightened policy by those in charge of factories, by the provision of appropriate safety devices, and of the highest importance, by the education of workers in factory technique which affords the greatest measure of safety.

Outstanding in the exhibition this year was the composite exhibit, an Ideal Factory, which within the limits imposed by the exhibition showed all the features of what such an establishment should be. It was sponsored by the Birmingham Productivity Association and a number of firms which had co-operated wholeheartedly in its construction and organization. Various jobs were demonstrated. In one case it was a stage in the making of domestic vacuum cleaners in which mechanical handling and a number of manual operations on an assembly line were illustrated. This was by the General Electric Co., Ltd. Three plastic moulding presses were shown by Joseph Lucas, Ltd. Two were fully automatic and one semi-automatic. Production of small brass pressings on a power press fitted with a strip feed of novel design was exhibited by the Birmingham Tool and Gauge Co., Ltd., and L. G. Harris & Co. had an automatic four-slide machine designed for the production of paint brush ferrules.

SUPERVISORS' WEEK-END CONFERENCE

Members of Supervisory Staffs of the Parkinson Stove Co., Ltd., and Monitor Engineering & Oil Appliances, Ltd., who attended a Supervisors' week-end conference at Ashorne Hill, Warwickshire, from June 3 to 5. The conference was organized by the Institute of Industrial Supervisors and Mr. David H. Bramley, Head of the Department of Industrial Administration, College of Technology, Birmingham. Among those seen in the photograph are Dr. A. Rees Jones, Director and General Manager of the Parkinson Stove Co., Ltd., and Mr. W. R. Childs, Director and General Manager of Monitor Engineering & Oil Appliances, Ltd., also Mr. David H. Bramley. In all 65 members of the Supervisory Staffs, including Section Leaders, were present. The object of the conference was to promote exchange of ideas and thus establish closer relationship between management and the works. Ashorne Hill is eminently suited for a conference of this nature, being situated in the beautiful county of Warwickshire.

South Western Section Ladies' Day

There was a total attendance of close on 100 members, ladies, and guests at the summer meeting and ladies' day of the South Western Section of the Institution of Gas Engineers on June 29, under the Chairmanship of Mr. W. B. Claridge, Engineer and Manager of the Swindon Division. By invitation of the Chairman and members of the South Western Gas Board, they assembled in the Empire Ballroom at the County Hotel, Taunton, for luncheon.

Mr. Claridge, after submitting the loyal toast, announced that apologies for absence and good wishes for a happy gathering had been received from Mr. W. K. Hutchison and Dr. W. T. K. Braunholtz, President and Secretary of the Institution of Gas Engineers, who were attending a meeting at Strasburg, and from the Chairmen and Secretaries of the other district sections. Pressure of Gas Board business also prevented the attendance of Mr. C. H. Chester and Mr. James Carr, Chairman and Deputy Chairman of the South Western Board, but he welcomed the other full-time member of the Board, Mr. W. J. Baker, who was attending in his capacity as a member of the Section. The summer meeting, Mr. Claridge emphasized, was a family gathering of members, ladies, and friends, and while there were to be no formal speeches his duty was to pay a tribute to the ladies. Gas engineers were so devoted to their professional duties that the life of the wife of a gas engineer was not always a happy one, and he welcomed the opportunity of ladies' day to assure all the ladies present of the very high regard in which they were held by the members.

The afternoon proceedings consisted of a visit to Montacute House, some four or five miles from Yeovil, one of the most famous possessions of the National Trust, and for some time the residence of the late Lord Curzon. Begun in 1588 and completed in 1601, Montacute House expressed in stone the rise to power and wealth of an astute lawyer, Edward Phelips, who rose to power under the last Tudor Queen and was tactful enough to increase his prestige under the first Stuart King. It was he who led the prosecution against Guy Fawkes in 1606 and became both Speaker of the House of Commons and Master of the Rolls. It is noteworthy that he took a stand against Charles I, while one son became a Colonel in the Royalist Army and another helped Charles II to escape after Worcester. The family held the estate for well over 300 years. The house, which is built of the local warm yellow stone of Ham Hill, is H-shaped and of three tall storeys with far more window space than exterior wall space. The rectangular stone mullioned windows of Montacute form perhaps its most attractive feature. The forecourt of the Eastern side is enclosed by an enchanting wall with open balustrades, toy temples, and bower-like stone pavilions very ornately decorated.

After the conducted tour of the house and informal inspection of the beautiful grounds, the guests were entertained to tea in the restaurant nearby the house. This was another occasion when speeches would have been out of keeping with the spirit of the occasion, but there were more intimate and informal expressions of appreciation of the South Western Gas Board's hospitality, of congratulation to Mr. and Mrs. Claridge on a very enjoyable ladies' day, and of praise of the work of the Hon. Secretary, Mr. E. V. Dunn, in carrying out the detailed arrangements to everyone's satisfaction.

Western Juniors' Summer Meeting

The recipe for a successful summer meeting and ladies' day may be said to be a fine sunny day, a goodly number of members and their ladies, and a good programme which is well organized. All these ingredients went into the making of the Western Juniors' summer meeting on June 18, when some 72 members and their ladies joined the President, Mr. F. G. Craxford, and Mrs. Craxford at the County Hotel, Taunton, for lunch.

The President welcomed Mr. L. P. Ingram, Chief Engineer of the South Western Gas Board, and Mrs. Ingram, and also Mr. T. W. Jackson, Engineer and Manager, Taunton and Weston Division, and Mrs. Jackson, and said how pleased they were to have senior members of the Board at their functions.

In welcoming the Western Juniors to Taunton, Mr. Jackson said he was always pleased to see them and congratulated the President on a very successful year of office.

Mr. Ingram, replying to the toast of the visitors, said he was pleased to visit Taunton again and referred to his association, before the days of nationalisation, with Mr. Craxford at Taunton. Mr. Ingram referred to ladies' day as a compensation to the ladies for the many times their husbands were away attending meetings of the Association. The Juniors had the backing of the Board, continued Mr. Ingram, and they looked to the juniors for the senior officers of the future.

After lunch the party travelled by coach and car to Minehead via the Quantock Hills and Blue Anchor. The bright sunshine gave the Somerset countryside all its fullest colours and a thirsty party arrived at Minehead for a welcome tea. The return journey was made over Exmoor via Dunkery Beacon to Taunton. Here the Social Club of the Taunton District was made available to members who were able to complete an excellent day in congenial surroundings.

Guernsey Cookery Demonstrations

Following her successful series of gas cookery demonstrations in Jersey in February, Miss Helen Main, Chief Demonstrator for R. & A. Main, Ltd., returned recently to the Channel Islands, this time to Guernsey, to carry out a programme sponsored by the Guernsey Gas Light Company. Again the continued popularity of this type of demonstration was proved by large attendances.

The first demonstration was opened by Miss Gladys Peck, President of the Women's Institute on the Island, who was welcomed by Mr. C. B. Blampied, Chairman of the Guernsey Gas Light Company, Mr. S. G. Vane, Manager, and Mr. R. G. Luxon, former Manager. Using No. 20 'Century' and No. 109 'Economain' cookers, Miss Main presented a variety of interesting recipes, all chosen for their ease of preparation. One session consisted entirely of simple Continental dishes featured at the International Food Fair, and on the Wednesday afternoon the programme was made up of recipes specially selected by the Produce Committee of the Women's Institute, under the heading of 'Quick Supper Dishes.'

Burnmoor Coke Ovens Nearing Completion

A new £2 mill. coke oven plant at Burnmoor, Co. Durham, on which work began in 1952, will be ready for operation by September this year, it is announced by the Durham Division of the National Coal Board. The date has been put back as a result of the rail strike. The new plant, which comprises 52 coke ovens, will be able to carbonize coal at the rate of 1,000 tons a day, supplying 7½ mill. cu.ft. of gas to the North East network of the Northern Gas Board. At present the ovens are going through the protracted 'drying out' stage.

Construction of the new plant has presented a number of engineering difficulties, chiefly arising from the need for the plant to be built as close as possible to the old coke works which it replaces. It covers about four acres and will draw its coal supplies from Lambton 'D,' Lady Ann, and Herrington collieries. A number of pit heaps have been eliminated in the work of clearing and levelling the site for the new plant, which is part of the Coal Board's six-year carbonization and development plan.

Plant Inauguration at Smethwick

For the second time within a few months, the West Midlands Gas Board has had the pleasure of arranging the inauguration of a substantial extension to one of its works. On April 20, the new plant at Stoke-on-Trent was officially inaugurated by Sir Harold Smith and last Thursday, June 30, a similar ceremony was formed at Smethwick gasworks in the Birmingham Division of the Board. On this occasion, the unveiling of a commemoration plaque was carried out by the Mayor of the County Borough of Smethwick, Councillor Mrs. E. Seager, J.P., in the presence of a large gathering representing all sections of the gas industry and local civic life. The new plant, which will be described in some detail in our next issue, includes a new carbonizing plant, consisting of two benches each of 16 Woodall Duckham continuous vertical retorts, tower purifiers by W. C. Holmes and Co., Ltd., and a 2 mill. cu.ft. spirally-guided gasholder by Horsley Bridge and Thomas Piggott, Ltd. The retort installation is complete with coal and coke handling plant, coke screening and storage plant, two waste heat boilers, dust extraction and vacuum cleaning plant, also various ancillaries comprising condensers, exhausters, hot and cold electrical detarrers, a solid fuel boiler plant and a water softening plant.

Following a tour of the new works, the visitors were entertained to luncheon by the West Midlands Gas Board at the New Inns, Handsworth, Birmingham. Proposing the toast of the County Borough of Smethwick, Mr. G. Le B. Diamond, welcomed the Mayor as chief citizen of the County Borough, also the many others representing the civic and industrial life of the Borough. Referring to the new plant which the visitors had just seen, Mr. Diamond said: 'Birmingham basks in the reflected glory of the achievements of Boulton and Watt, and their Soho factory was, and is, situated in Smethwick. This historic site is adjacent to our Smethwick gasworks. It was to this place that William Murdoch came seeking a job as a poor apprentice. He was engaged by Matthew Boulton and, in 1778, sent to Cornwall in charge of engine building but, while there, he turned back to early experiments he had made with coal gas and, in 1792, introduced gas lighting into his house at Redruth. In 1798 he was back in Soho and was successful in lighting by gas for the first time part of the Boulton and Watt factory. It was on that very site that the first public display of gas lighting was made on the occasion of the celebration of the peace of Amiens in 1802 and about this time Murdoch discovered the means of storing gas.'

Mr. Diamond spoke of the work of the West Midlands Gas Board and the contribution it was attempting to make to the community. 'It is a considerable enterprise by any standards,' he said, 'for its turnover is in the region of £30 mill. a year. It carbonizes over 3.4 mill. tons of coal per annum and this large tonnage requires the whole time employment of no less than 10,000 miners at the coal face, engaged entirely in winning coal for the West Midlands Gas Board. In 1948 the Board paid £8,407,899 for just under 3 mill. tons, and now it has to pay £14,400,000 for 3.4 mill. tons. The additional cost due to the increase in the price of coal of 27s. 4d. per ton since 1948 amounts to just under £5 mill., or 47%. Through circumstances outside the control of the Board there have been several increases in the price of gas since nationalisation, and there is another one imminent, but it is the first since 1953. Critics often appear to think that the nationalised industries possess some secret means of shielding the public from the effects of the inflationary spiral. We can do something in this direction and the West Midlands Gas Board has made a contribution, by internal economies, higher operational efficiency and other savings, which has absorbed just under £1 mill., which otherwise would have been passed on to the consumer.

'Even today the price of gas in the Board's Area is the third lowest in the whole country and, of the two Boards that take the lead, a considerable proportion of the gas sold is derived from coke ovens on very favourable contracts. The gas industry's contribution to smoke abatement is well known and, if the Beaver Committee's Report is implemented by a Statutory Enactment, it is certain that the industry will be required to produce much larger quantities of smokeless fuel. The new plant at Smethwick is particularly adapted for this purpose and in a full year will be able to turn out approximately 61,000 tons of excellent smokeless free-burning coke.'

News in Brief

A New Showroom was opened by the Scottish Gas Board, Lochgelly, Fife, on June 30. At a social function afterwards Mr. Robert Meldrum, St Andrews, was presented with a wireless set in recognition of his 41 years service in the gas industry. The gift was handed over by Sir Andrew Clow, Chairman of the Scottish Gas Board.

The Board of the Pyrene Company, Ltd., fire extinguisher makers, etc., of Brentford, and Minimax, Ltd., fire engineers, of Bedfont, announce that the offer by the former to acquire the share capital of the latter at 16s. 3d. per 5s. ordinary share has been successful. Acceptances have been received in respect of more than 90% of the Minimax shares and the offer has become unconditional.

Perth is Making Progress towards becoming a smokeless city. The city sanitary inspector, Mr. W. McBryde, says in his annual report that the Town Council will soon have smokeless fuel plants in the 14 main municipal buildings in the city or there will be mechanical equipment which would reduce smoke to a minimum.

Increasing Business has made it necessary for F. E. Weatherill, Ltd., to remove from Union Row, N.17, to larger premises at Tewin Road, Welwyn Garden City (T/N Welwyn Garden 4221). The associated company, F. E. W. Spares & Service, Ltd., will continue to operate from its present address at Union Row, N.17 (T/N Edmonton 4707).

The North Western Gas Board sold 117,000 tons of coke in the four weeks ended May 29; an increase of 22% over the total of 96,000 tons sold in May, 1954. Coke sales in the first two months of the Board's current financial year amounted to 280,000 tons and were up by 17% compared with the total of 240,000 tons sold in the same period of the previous year.

Peterborough City Engineer has been instructed by his Council to investigate further a scheme for the provision of washing machines in new council houses by the conversion of a new type of gas boiler.

The National Coal Board has successfully completed an experiment in burning low grade fuel which may result in considerable savings in cost and release better grade coal for the market. It has been using a new type of mechanical stoker, which is fully automatic, to burn fine particles of coal and soluble shale rejected from washeries. This is common practice on the Continent, and German and Dutch engineers have proved that they can make electric power more cheaply than it can be bought from the grid. It was after a study of these methods that the Coal Board decided to install what is the first plant of this type to operate in the country.

Diary

July 4.—NORTH EASTERN GAS BOARD SALESMEN'S CIRCLE (BRADFORD GROUP): Visit to the Rustless Iron Co., Ltd., Keighley, 6.30 p.m.

July 5.—SOUTH EASTERN G.C.C.: Caxton Hall, Westminster, London, 11 a.m.

July 6.—NORTH EASTERN GAS BOARD SALESMEN'S CIRCLE: Area Meeting. Visit to the works of Thomas De La Rue, Ltd., Warwick.

July 8.—MANCHESTER AND DISTRICT SECTION, I.G.E.: Chairman's Day, Liverpool.

July 11.—NORTHERN G.C.C.: 30, Grainger Street, Newcastle-upon-Tyne, 11.15 a.m.

July 13.—SCOTTISH G.C.C.: Gas Board Offices, 26, Drumsheugh Gardens, Edinburgh, 11.30 a.m.

August 15.—EASTERN G.C.C.: Connaught Rooms, Great Queen Street, Kingsway, W.C.2, 2.30 p.m.

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GAS JOURNAL. *(Weekly.* Wednesday, By Post, **1s. 5d.)**

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Annual Subscription (including a copy of the "Gas Journal" Calendar and Directory): Home and Empire, **52s.** ; Foreign, **60s.**

GAS SERVICE AND DOMESTIC COKE.

(Monthly. By Post, **1s. 2d.)**

"Gas Service and Domestic Coke" is the specialist magazine for the Sales and Service personnel of the Industry. It covers all aspects of gas service from the holder to the burner and contains a special large section each month devoted to the utilization of coke. In addition to sound editorials, news items and specially contributed articles, "Gas Service and Domestic Coke" also reports in the fullest possible manner the activities of the numerous Salesmen's Circles, and Solid Fuel Bodies.

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BOOKS and ANNUALS . . .

Some current works covering the manufacture, distribution, and sale of gas are :—

KING'S MANUAL OF GAS MANUFACTURE. Now being issued in 10 self-contained sections. Sections available and prices on application.

MANUAL OF GAS FITTING. By R. N. Le Fevre. **30s.**

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High Pressure Gas Main Construction (Restall), **10s. 6d.**

ANNUALS:—

"Gas Journal" Calendar and Directory, 25s. ; "Gas Service" Pocket Book 5s.

BINDING . . .

In addition to permanently binding subscribers' journals, (particulars and prices for which we shall be pleased to give on application) we can supply TEMPORARY BINDERS for the Gas Journal, Gas Service and King's Manual of Gas Manufacture, thus enabling readers to *bind their copies as received.* The danger of mislaid or damaged copies is eliminated.

Gas Journal temporary binder } . . . . . **13s. 3d.** each inc. postage.
Gas Service " }
King's Manual " . . . . . **9s. 9d.** each inc. postage.

PHOTOGRAPHY . . .

Walter King Photographs specialize in Gas Industry photography of every description—work in progress series, plant, appliances, showroom displays, exhibition stands, social and educational visits of all kinds. Tours for various areas of the country can be arranged. First class photography at competitive rates. Full particulars on application.

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As a result of extensive research ROZALEX LIMITED announce the development of ROZALEX BARRIER CREAM NO. 12 specially designed to protect the skin against PITCH, TAR, ASPHALT, and photosensitising materials which produce skin conditions varying from mild erythema (redness) to exudating dermatitis and skin cancer. The causative factor, ultra violet light, is controlled by this barrier cream, which contains a light screen.
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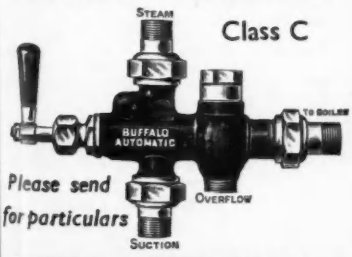

Please send for particulars
GREEN & BOULDING, Ltd.
162a Dalston Lane, London, E.8

APPOINTMENTS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18–64 inclusive or a woman aged 18–59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order, 1952.

APPLICATIONS are invited for the post of GENERAL MANAGER of new Low Temperature Carbonisation Plant now in course of erection at Edwinstowe, Nottinghamshire. Plant when completed will carbonise 250 tons of coal per day, increasing in a few years to 500 tons per day. Applicants, preferably between 30 and 45 years of age, should have good technical qualifications and experience in either the coke oven or gas industry.
Salary range £850 to £1,250 according to qualifications and experience.
Applications, including details of age, education, qualifications, experience, and also giving an indication of present salary, should be addressed in confidence to the Managing Director, Midland Rexco, Ltd., Mansfield Colliery, Mansfield, Notts.

SALES AND SERVICE ENGINEER required for Natural Gas undertaking in WEST PAKISTAN. Applicants must be qualified Industrial Gas Engineers and have full knowledge of the utilization of gas and other fuels in Industrial and Commercial establishments together with wide experience of the design, development and operation of Industrial and Commercial gas burner equipment, including controls. Attractive salary, 3 year contract and other benefits. Write with details of qualifications and experience to Box G.J.652, c/o, 191, Gresham House, E.C.2.

INDUSTRIAL MAINTENANCE ENGINEER required for Natural Gas undertaking in WEST PAKISTAN. Applicants must have practical experience in the construction, operation, etc., of all types of Industrial and Commercial plant where gas and other forms of fuel are utilized and should be capable of carrying out adjustment and maintenance of burners and controls and of supervising and training native fitters. Attractive salary, 3 year contract and other benefits. Write with details of qualifications and experience to Box G.J.653, c/o, 191, Gresham House, E.C.2.

WEST MIDLANDS GAS BOARD
WOLVERHAMPTON AND DISTRICT DIVISION
APPLICATIONS are invited for the following positions in the Divisional Engineer's Drawing Office, Dudley.
DRAUGHTSMAN
Candidates should have had experience in an Engineering Drawing Office; a knowledge of Gas Works plant will be an advantage but is not essential.
Salary will be within Grade 7 (£620-£700 per annum) of the National Salary Scales.
DRAUGHTSMAN
Candidates should have had experience in engineering draughtsmanship, structural and building work. Previous experience with gas works plant is desirable. They should be capable of carrying out surveys and the preparation of drawings, specifications and estimates. The minimum qualifications expected will be of Higher National Certificate standard.
Salary within Grade 9 (£700-£800 per annum) of the National Salary Scales.
Applications, stating age, qualifications and experience, together with the names of two referees, should be adressed to Mr. Stanley Jones, Divisional General Manager, West Midlands Gas Board, Kensington House, Bath Street, Dudley, to reach him within fifteen days of the appearance of this advertisement.
J. C. INGRAM,
Secretary to the Board.

(Classified advertisements continued on page 86)

There are viewers . . .

. . . and viewers, of course. The evil eye seen above may be looking for atom plans, ankles, or evidence, but this is not the sort of viewer we had in mind. The stereoscopic viewer, showing 3-D pictures in colour, is the salesman's latest weapon, and its usefulness increases in direct relation to the size of the thing he is selling. You pop in a slide, press the button, and there you are—you are there. But the production of slides is a job for the expert. If you are interested, you would be well advised to contact **Walter King Photographs** at 11, Bolt Court, Fleet Street, E.C.4. (CEN. 2236).

APPOINTMENTS VACANT (*ctd.*)

EXPERIENCED Contractor's Agent required, Permanency; for supervision of Gas and Water Mainlaying Contracts. Home Counties. Accommodation. State age, salary, full experience. Apply No. 243, *Gas Journal*, 11, Bolt Court, Fleet Street, London, E.C.4.

MINISTRY OF HOUSING AND LOCAL GOVERNMENT: INSPECTOR OF ALKALI, ETC., WORKS. The Civil Service Commissioners invite applications from men for one pensionable post as Inspector under the Alkali, etc., Works Regulation Act, 1906. Candidates must be university graduates in science or technology and preferably also Corporate Members of the Institution of Chemical Engineers, or Fellows or Associates of the Royal Institute of Chemistry, but exceptionally a candidate possessing other appropriate qualifications and of outstanding ability may be admitted. A wide working experience of the heavy chemical and related industries is essential. Age at least 35 on May 1, 1955. Salary Scale (London) £1,280 (at age 37) with a deduction of £45 for each year below that age—£1,525. Remuneration for a 45½ hour week in London approximately £1,420 (at age 37)—£1,658. Provision for starting pay above the minimum for an outstandingly qualified man.

Application form and particulars from Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1, quoting No. S4485/55. Applications to be returned by August 16, 1955.
6856/120/6/55/FW.

EAST MIDLANDS GAS BOARD

A PRESS OFFICER is required by the Board. He will work in the Public Relations Section of the Commercial Manager's Department at Leicester. Newspaper experience is essential and a knowledge of the East Midlands is desirable.

The commencing salary will be within the range of Grades A.P.T. 8 and 9 (males £660-£800 per annum).

The post is superannuable and the successful candidate will be required to pass a medical examination.

Applications stating age and experience, together with the names of two referees, should be addressed to the undersigned to arrive not later than July 22, 1955.

A. GWYNNE DAVIES,
Secretary.

Beverley House,
University Road.,
Leicester.

REPRESENTATIVE required by well established manufacturers of instruments widely used in gasworks and in gas distribution to call on gasworks and big gas users in London and Home Counties.

Applicants should have had some training either in gas manufacture or distribution and experience as a representative, not necessarily in instruments as training will be given.

Remuneration by salary. A car is provided and travelling expenses are paid.

This position offers interesting work with plenty of scope in a progressive organisation. Write giving age, details of education and training, previous positions held and remuneration expected, to the Directors, Walker, Crosweller & Co., Ltd., Whaddon Works, Cheltenham.

NORTH WESTERN GAS BOARD

NORTH CHESHIRE GROUP
TECHNICAL ASSISTANT (DISTRIBUTION)

APPLICATIONS are invited for the above pensionable appointment in the Group Distribution Engineer's Department at a salary within Grade A.P.T. 5 (£530-£610 per annum).

Applicants should have experience in the distribution of gas (high and low pressure), main and service laying, survey work and general drawing office practice. Possession of the Ordinary Grade Certificate of the Institution of Gas Engineers in Gas Engineering (Supply) is essential.

Applications giving details of training, qualifications and experience, together with the names of two referees should reach the General Manager, N.W.G.B. (North Cheshire Group), Great Portwood Street, Stockport, within fourteen days.

EASTERN GAS BOARD

NORWICH DIVISION
INDUSTRIAL GAS ENGINEER

APPLICATIONS are invited for the position of an INDUSTRIAL GAS ENGINEER in the Norwich Division. Applicants should have had experience in the design, construction and installation of industrial and commercial plant covering a range of representative industries.

The commencing salary will be within Grade A.P.T. 12, Provincial 'A' (£835 to £960) and the initial placing on the Scale will be according to experience and qualifications.

The successful candidate may be required to pass a medical examination and unless already subject to a pension scheme, by virtue of the Gas (Pension Rights) Regulations, 1950, will be required, if eligible, to join the Board's Staff Pension Scheme within six months from taking up the appointment.

Applications stating age and giving full particulars of education, training and qualifications and experience, should be sent within 14 days of the appearance of this advertisement, to the General Manager, Norwich Division, Eastern Gas Board, Thorpe Lodge, 1, Yarmouth Road, Norwich, Norfolk, endorsed 'Industrial Gas Engineer.'

EASTERN GAS BOARD

WATFORD DIVISION
HOME SERVICE ADVISERS

APPLICATIONS are invited to fill two vacancies:

(1) HOME SERVICE ADVISER at Watford. She should have had at least two year's training, possess a recognised diploma and, preferably, have had experience in the gas industry. She should be capable of taking over all home service activities in her district, including public demonstrations of cooking and home laundry, talks to women's organisations and visiting consumers in their homes to advise on the correct use of gas appliances, survey work in consumers' homes, liaison with domestic science organisations, etc.

Commencing salary, depending on age, qualifications and experience, will be between £322 and £502 per annum (A.P.T. 3—A.P.T. 5 "Metropolitan").

(2) HOME SERVICE ADVISER at St. Albans. Qualifications as above. Salary £314-£494 (A.P.T. 3—A.P.T. 5, "Fringe" Metropolitan).

The successful candidates may be required to pass a medical examination and, unless already subject to a Pension Scheme by virtue of the Gas (Pension Rights) Regulations, 1950, will be required, if eligible, to join the Board's Staff Pension Scheme within six months of taking up the appointments.

Applications, stating age, education, qualifications and experience should be addressed to the Divisional General Manager, Eastern Gas Board, Watford Division, Radiant House, Clarendon Road, Watford, to be received not later than July 15, 1955.
June 27, 1955.

TWO FIRST CLASS FITTERS urgently required— must be single men. Full J.I.C. Rates (Provincial "A" and Conditions of Service).

The successful candidates may be required to pass a medical examination.

Accommodation can be arranged.

Applications, giving details of age, present duties and references, should be made to the undersigned within two weeks of the appearance of this advertisement.

F. N. Howes, Group Manager, Eastern Gas Board —Ipswich Division, Gas Works, Chelmsford, Essex.

NORTHERN GAS BOARD

SUNDERLAND DIVISION
SUNDERLAND UNIT

APPLICATIONS are invited for the following vacancies.

SENIOR CHEMIST, Hendon Works, Sunderland.

Candidates should be suitably qualified to undertake full responsibility under the Works Manager for supervision of Chemical Staff, routine testing and control of sections of the Works Plant.

The appointment will be within A.P.T. Grade 9 (£700/£800), of the National Salary Scales for Gas Staffs.

ASSISTANT DISTRIBUTION SUPERINTENDENT, Hind Street Distribution Department, Sunderland.

Candidates must have knowledge of all aspects of modern distribution practice, general administration of a Distribution Department and practical experience of main and service laying, both high and low pressure, gasfitting, public lighting and the control of employees.

The possession of the Higher Grade Certificate in Gas Engineering (Supply) would be advantageous.

The commencing salary will be within A.P.T. Grade 10 (£760/£860) of the National Salary Scales for Gas Staffs.

TECHNICAL ASSISTANT, Hendon Works, Sunderland.

Candidates should be conversant with Gas Works Plant or Coke Oven practice and be familiar with routine laboratory tests.

The commencing salary will be within A.P.T. Grade 6 (£565/£645) of the National Salary Scales for Gas Staffs, on an appropriate step according to experience.

The successful candidates will be required to pass a medical examination and will be subject to the Board's Pension Scheme.

Applications stating age, experience, qualifications and giving the names of two referees should be addressed to the undersigned within 14 days of this advertisement.

W. O KIRKWOOD.
Divisional General Manager.

P.O. Box No. 39,
Fawcett Street,
Sunderland.
June 20, 1955.

EDUCATIONAL

THE UNIVERSITY OF LEEDS

GAS PLANT MANUFACTURERS' DEVELOPMENT COUNCIL SCHOLARSHIP

APPLICATIONS are invited for the above Scholarship of a value of up to £215 a year; in special circumstances a higher award of up to £280 a year may be made. The Scholarship is provided to enable promising students to follow an Honours course in either Gas Engineering or Chemical Engineering as preliminary training for entry into the Gas Plant Industry.

The Scholarship is open to applicants of British Nationality from school or from industry; among the latter preference will be given to candidates already engaged in the Gas Plant Industry.

Applications should reach the Registrar, The University, Leeds, 2, from whom further particulars and forms of application may be obtained, not later than July 31, 1955.

APPOINTMENT WANTED

REPRESENTATIVE, fully experienced, recommended by Past President, desires change of Post. Connections with Sales and Distribution side of the Industry—part-time Representation considered. Apply: No. 246, *Gas Journal*, 11, Bolt Court, Fleet Street, London, E.C.4.

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'Phone: TEMPLE BAR 9910. *'Grams:* WASHER, ESTRAND, LONDON

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Consider the alternative.

The "Tornado" method of man-cooling definitely encourages production all the time. Man-cooling fans deliver, for as long as is necessary, a brisk, cooling air current which relieves excessive body heat and improves breathing conditions. Designed particularly for use in the "heavy" trades they combine an easy portability with robust construction — two essential characteristics.

If your concern is for workers in iron and steel works, foundries, boiler houses, gas retort houses, glass works or "lighter" industries where efficiency is bound up with the maintenance of comfortable working conditions then you should see Publication No. 9/7.

A copy is waiting for you.

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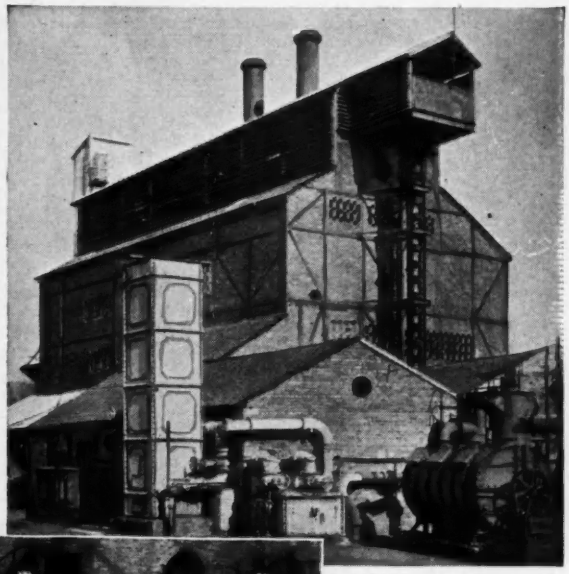
Work in Scotland

SOME CURRENT AND RECENTLY COMPLETED CONTRACTS

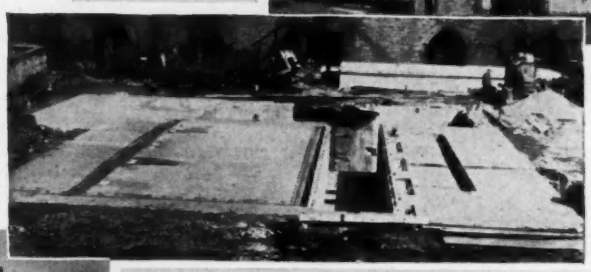


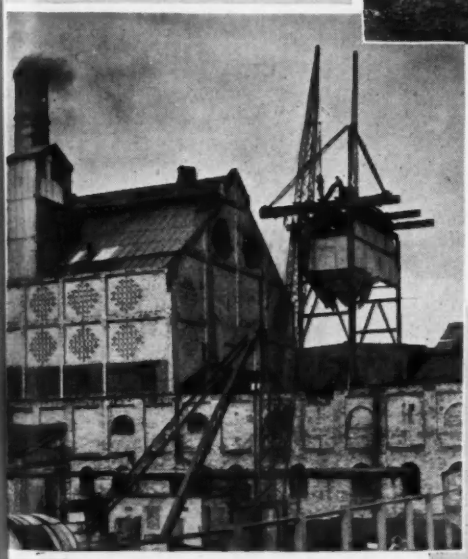
DUNOON

Interior reconstruction and modernization, after 40 years continuous service, of the installation of 12 Glover-West Vertical Retort

DUMFRIES

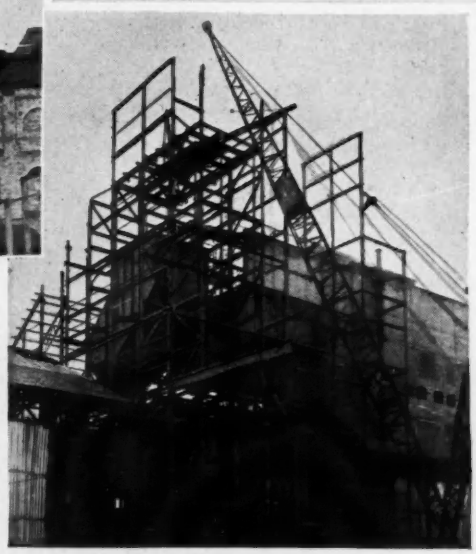
Foundation work for complete new installation of 12 retorts





KILMARNOCK

Extension to existing plant of 24 retorts by a further 16 retorts with new coal handling plant



FALKIRK

Extension to existing plant of 56 retorts by a further 16 retorts, with mechanical producers and new coal handling plant

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GAS IMPROVEMENT CO. LTD

Miles Platting, Manchester 10

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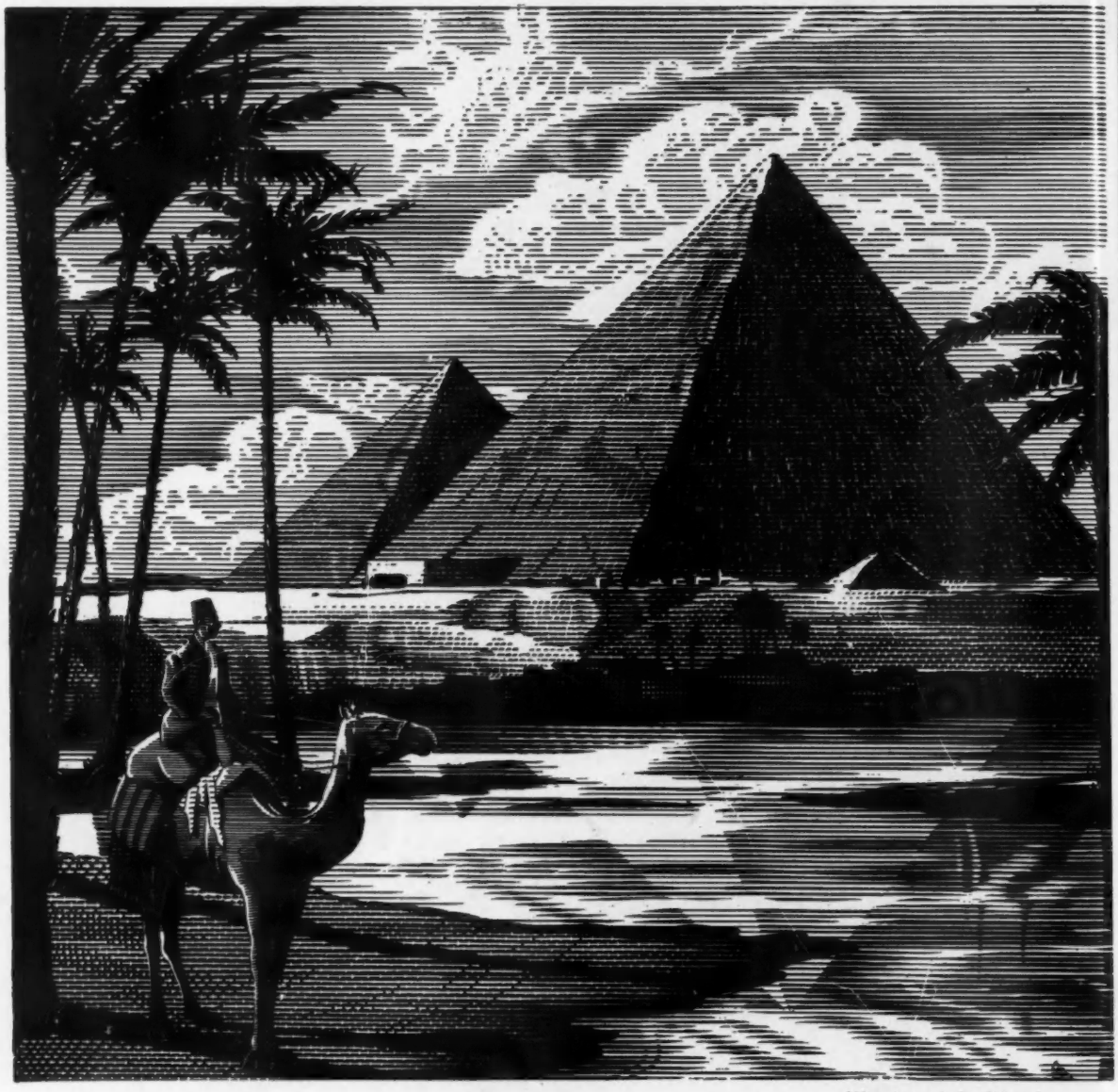
SC1



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The PYRAMIDS of EGYPT

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